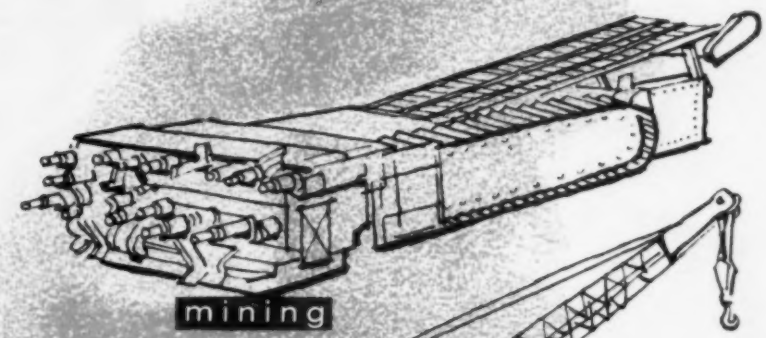
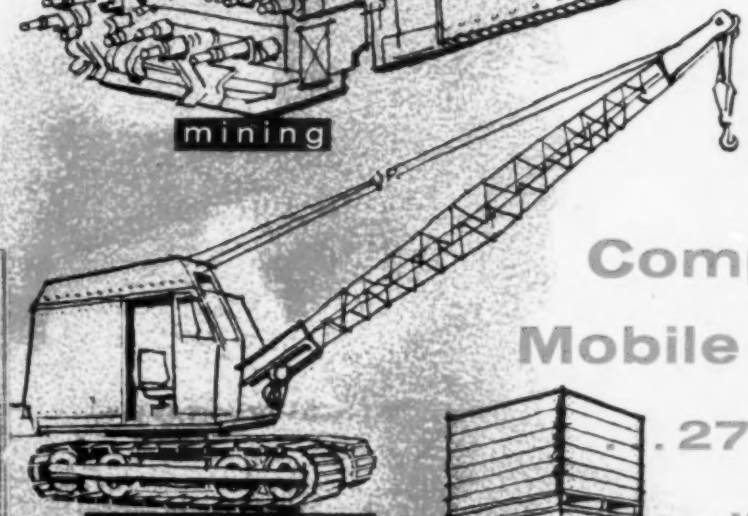
Applied Hydraulics

PNEUMATICS · ELECTRICAL CONTROLS



mining



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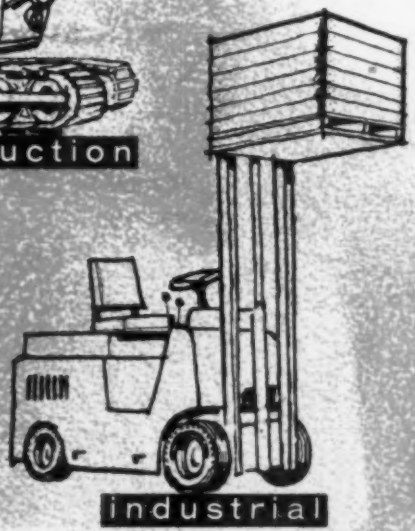

industrial

DECEMBER
1957

Components for Mobile Equipment

. 27 designers tell what they need

page 65

STEVENS RICE
UNIVERSITY MICROFILMS
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THE MAGAZINE OF FLUID POWER

AN INDUSTRIAL PUBLISHING CORPORATION MAGAZINE

For information about
THE JANUARY 1958 DESIGNERS' GUIDE ISSUE
see page 8

shuts off both sides of line... prevents loss of liquid, gas, or pressure.
Available in brass or steel with female pipe thread connections from ⅛" to 1"
FOR PRESSURE OR VACUUM SERVICE

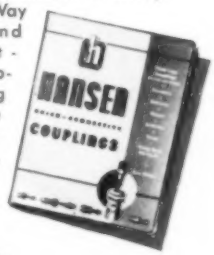
HANSEN

QUICK-CONNECTIVE TWO-WAY SHUT-OFF COUPLINGS

Both ends of line are positively sealed when you disconnect a Hansen Series HK Two-Way Shut-Off Coupling. To connect, just pull back sleeve and push Plug into Socket. To disconnect, merely pull back sleeve. No tools required. Identical valves in Socket and Plug permit free flow of gas or liquid when Coupling is connected—practically eliminate spilling of liquid or escape of gas when disconnected.

WRITE FOR THE HANSEN CATALOG

Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for Steam, Oxygen, Acetylene, etc.



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SINCE 1915

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CIRCLE 49 ON READER SERVICE CARD

CONTROL FLUID FLOW

with Micrometer Accuracy

HANNA Flo-Set VALVES

For AIR, OIL and WATER operation to 250 p.s.i.
SIZES ¼" • ⅜" • ½" • ¾"
TEMPERATURES to 250°F

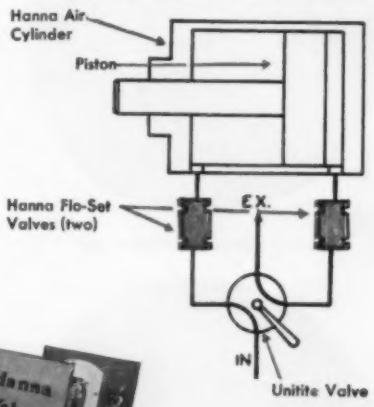
Hanna Flo-Set Valves are used to control cylinder piston speeds and operating speeds of many types of fluid actuated mechanisms. They are able to handle air, oil, water and many gases. When used with cylinders, these valves permit independent adjustments of forward and return piston speeds. The diagram at the right shows a typical circuit. Flo-Set Valves make the operation of air cylinders smoother and make cushioned cylinders more effective by building up essential back pressure.

Fluids pass unobstructed in the direction of the arrow on Hanna Flo-Set Valves. In the opposite direction, flow can be controlled from zero to full pipe capacity. One valve can be set to an infinite number of controlled flow positions. Once set, the position can be held by means of a locking collar. Established flow positions can be reset by using the micrometer graduations which accurately measure flow as a percent of full pipe capacity.

One revolution of the aluminum valve body will change the flow rate from zero to full capacity. No tools are necessary! In addition to the standard ¼", ⅜", ½" and ¾" sizes, there is a ¼" Jr. model, without micrometer graduations or locking collar, for light piping and tubing.

Typical Cylinder Circuit Using Hanna Flo-Set Speed Control Valves

Hanna engineers will gladly recommend circuits to help you with your applications.



Consult your classified telephone directory or Thomas' Register for your nearest Hanna representative. Write for Hanna Valve Catalog 254 and Flo-Set Valve Bulletin 253A.

Hanna Engineering Works

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

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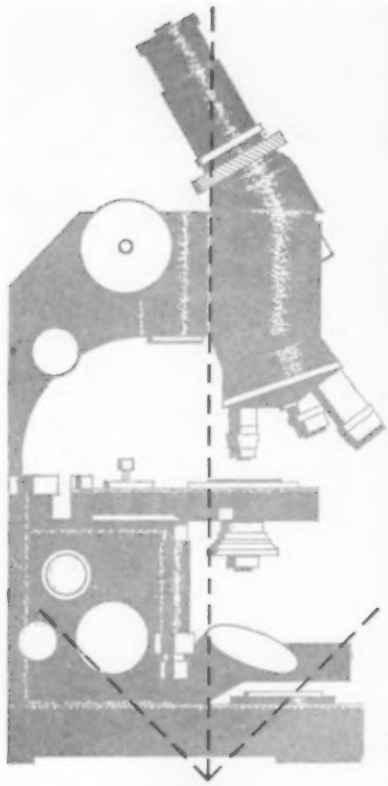
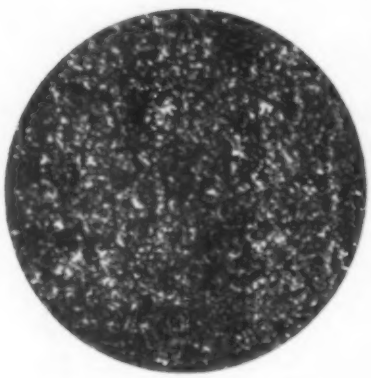
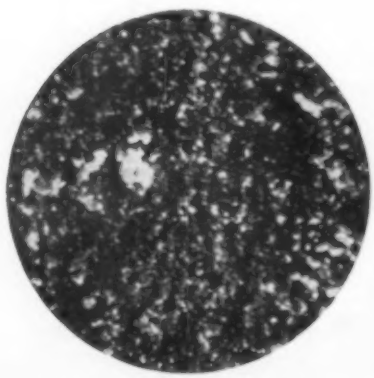
CIRCLE 47 ON READER SERVICE CARD

how injection molding can help you solve design problems and improve products that require rubber parts . . .





Modern injection molded rubber.



Standard compression molding.

Greater density produced by injection molding of rubber is shown in comparison to ordinary compression molding. Injection molded rubber (top) displays homogeneous characteristics unequalled for consistency or toughness by any other process. In application, this will mean tremendous resistance to abrasion and chemical action—much longer life for rubber parts. Both microphotographs are standard Buna N compound, approx. .269″ x .019″, magnified 240 diameters by the University of Minnesota.

The unequalled high density that results from *injection molding* of organic, synthetic, and silicone rubber compounds offers the key to optimum performance from rubber parts. Minnesota Rubber and Gasket Company uses an exclusive injection molding process that provides matchless product consistency and tolerances as close as .002 inch, all on a mass production scale. Custom compounding and laboratory facilities for research, problem analysis and product development are among the many additional services offered you.

TYPES OF PARTS

1. *Custom Molded* . . . an almost limitless variety of shapes, sizes and types of parts can be molded by Minnesota Rubber. An extremely broad range of compounds can also be used or formulated to meet your most exacting dielectric, temperature or other special requirements.
2. *Metal Bonded* . . . drive wheels, diaphragms, pump impellers and similar precision, metal-rubber parts are a specialty of Minnesota Rubber. Injection molding securely bonds metal and rubber and permits closer tolerances (as close as .001″ on wheels). Complete metal processing facilities are provided including plating and insert fabrication.
3. *Sub-miniature* . . . gaskets with round cross sections as small as .020 inch are but one of many minute parts produced by Minnesota Rubber. Sub-miniature fabrication is carried on in a variety of compounds including, Neoprene, Buna N, and various silicone rubbers.
4. *Seals* . . . O-ring seals are produced and stocked by Minnesota Rubber in a complete range of standard sizes. Special sealing problems also receive immediate attention and solution. Also available is the revolutionary QUAD® RING , an exclusive development of Minnesota Rubber.

NOTE ON ECONOMY

Lower costs both in product development and production will be yours because of Minnesota Rubber's complete facilities and mass production techniques. Injection molding not only permits greater economy through higher efficiency, but it eliminates many secondary finishing steps required by other molding processes. In addition, the most modern production systems and new plant facilities assure you of fast production, quick delivery—no expediting costs.

QUALITY CONTROL

Statistical sampling and laboratory analysis during every phase of production assures you of the finest quality in finished parts. This means extra savings in rejects and replacement costs . . . greater dependability, longer part life.

SAMPLES AND DATA

FREE Samples and detailed data are available so that you can inspect and test Minnesota Rubber products. Your material will be forwarded to you promptly and without obligation if you will write Minnesota Rubber at the address below. Please specify product interested in.

QUAD RING is a Trade Mark of the Minnesota Rubber & Gasket Company.

MINNESOTA RUBBER & GASKET CO.

Originators of modern rubber injection molding
3630 Wooddale Ave., Minneapolis 16, Minn.
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CIRCLE 67 ON READER SERVICE CARD

Applied Hydraulics

DECEMBER 1957 Vol. 10, No. 12 BPA

MOBILE EQUIPMENT FLUID POWER COMPONENTS

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THE MAGAZINE OF FLUID POWER

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Worcester's New Econ-O-"Miser" Ball Valve* is BOTH

VALVE and UNION

The costs of a union and installing it are eliminated. Add to this the longer operating life of the Econ-O-"Miser," the time and materials savings of *in-line maintenance,* and you get performance unmatched by *any* valve at *any* price.

The Econ-O-"Miser" is available in Bronze, Aluminum, Aluminum Bronze, Forged Carbon Steel, types 303 and 316 Stainless Steel. Seat and seal materials available. Teflon, Buna-N and Neoprene (others available on request.)

The many combinations of body and seat seal materials allow handling of exceptionally wide range of media.

Other Outstanding Features

- Compact for ease of installation
- Positive leakproof shut-off
- **In-line maintenance** permits quick, easy inexpensive repairs
- Two-way flow allows application of pressure or vacuum to either side of valve
- Quarter turn operation — readily adaptable to remote control
- Visual determination of OPEN — CLOSED positions — No manual check needed
- Round flow through the valve — minimum pressure loss and turbulence
- "Wiper-action" of resilient seat against ball eliminates abrasive wear due to foreign materials in media . . . assures leak-proof seal . . . long operating life

* Pat. Pending

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Applied Hydraulics

THE MAGAZINE OF FLUID POWER

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Published monthly by
THE INDUSTRIAL PUBLISHING CORP.
812 Huron Road, Cleveland 15, Ohio

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SUBSCRIPTION in United States and possessions—$5.00 per year; Canada—$6.00 per year; Foreign—$7.00 per year, except United Kingdom. United Kingdom subscription £ 3.0.0 per year, payable in Sterling to our London Office. Single copy price, 50 cents. All subscriptions subject to individual acceptance by the publisher.

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Useful Literature

New Condensed Catalog Covers Anchor Line

Users and manufacturers of hydraulic equipment, will find the new Anchor Condensed Catalog No. 57-S a most valuable adjunct to their engineering or maintenance files.

It contains a condensed, yet very complete presentation of the Anchor Line of Hydraulic Hose Assemblies, Couplings and Fittings. The Anchor Line is so reviewed as to greatly simplify selection of the correct Hose Assembly, Coupling or Fitting for any given application.

Included in this catalog are descriptions of the most standard Anchor Products, including Anchor Ductile Sleeve Couplings and other permanently applied Couplings with 2-Wire Braid Hose for high pressures, and with 1-Wire Braid Hi-Burst 2-Rayon Braid, or Spiral Wire Braid for medium and low pressures.

Also described are Anchor Reusable Couplings which include the commercial Duloc Couplings for QW and QWR Hose and Anchor Standard Reusable Couplings with 2-Wire Braid Hose for high pressures, with 1-Wire Braid Hose, Hi-Burst and Standard 2-Rayon Braid Hose for medium and low pressures.

Anchor FLANCO 4-Bolt Split-Flange "O"-Ring Couplings and Clamp-Type Hose Couplings for quick, easy emergency repair are listed.

The right fitting to suit practically any piping situation can be found in the Anchor Line of Adapter Unions and Pipe Fittings with its wide range of sizes and thread combinations.

Also shown are the new Anchor SAE Adapters and Fittings designed to SAE Straight Thread "O"-Ring Boss standards, which are carried in stock.

This new condensed catalog of Anchor standard stock products is now available on written request. Write Anchor Coupling Co. Inc., 386 North Fourth Street, Libertyville, Illinois, and ask for Catalog No. 57-S.

SAVE Time, Expense and Effort

with

ANCHOR FLANCO

4-Bolt, Split-Flange, "O" Ring

CLAMP

—with the **TILT-PROOF** *and* **BLOW-OFF PROOF DESIGN**

Flanco Split-Flange Couplings provide an easily-made, leak-proof "O" Ring Head connection. There are no threads to wear out, or tapered seats to groove—no wedging of pump or valve bodies by tapered pipe threads! The use of gaskets and sealing compound is eliminated—there is no spiral leakage. The higher the pressure, the tighter the "O" Ring seals!

Anchor Split-Flange Clamp design gives you a tilt and blow-off proof clamp. By locating the plane of the split-flange clamp half bolt centerlines so that it passes through the center of force of the flanged head on the split-flange clamp half, unbalanced moments are eliminated. This patented design principle prevents tilting of the clamp half and extrusion of the "O" Ring.

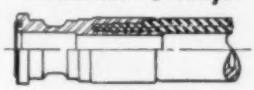
Anchor Flanco Split-Flange Couplings can be used to connect hose assemblies to valve or pump bodies, or, in pairs with connector plates, to connect hose to hose, or hose to pipe. They are available in sizes from ½" to 3" I.D. hose and in low or high pressure styles to provide a dependable, trouble-free connection.

A new Anchor Swivel Joint, with full 360° swivel, provides maximum convenience and flexibility in installation and avoids twisting and distortion of hose. They are available in all standard angles for high pressure 2-wire braid pressed-on hose assemblies from ½" to 2" I.D.

Andy Anchor Says:

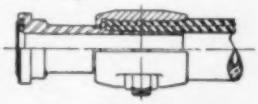
For the complete story of the many advantages offered by Flanco Split-Flange, 4-Bolt, "O" Ring Head Couplings and their time and money saving features, write for Catalog No. 401!

Available 4 Ways



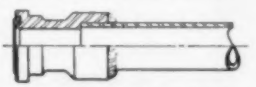
Pressed-On Couplings

Streamlined Couplings, factory applied to make dependable hose assemblies, utilizing the same time-proven hose swaging methods which have made Anchor the leader in the industry.



Clamp-Type Couplings

Ideal for making emergency repairs in shop or in the field with a minimum of down time. Also exceptionally well-suited for the plumbing of special or experimental units.



Weld-Type Couplings

Used to connect pipe or tubing to hydraulic hose, or for coupling pipe to system components, or pipe to pipe with quick, sure, leak-proof connections.

Stem-Angles

Available in Pressed-On or Clamp-Type Couplings, these stem-angles come in 22½°, 30°, 45°, 60°, 67½° and 90° basic angles. With the Flanco Swivel Split-Flange's 360° swiveling feature, universal positioning is provided.

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Fluid Power Lines

about Applied Hydraulics

MOBILE PLANNING . . . Back in January, the editors of APPLIED HYDRAULICS sat down to discuss a theme for this annual issue on mobile equipment. The idea finally selected was a special report based on personal interviews with manufacturers and users of fluid power operated mobile machines. This report would indicate what these people want in commercially available components . . . what difficulties they are having, and how their designs are limited by what they are now able to buy. The report would also cover components which mobile equipment designers have worked out for themselves—sometimes in cooperation with the component manufacturer.

Another important part of the report, it was decided, would tell what components are going to be required for future designs . . . higher pressures, faster pump speeds, better filtering. Where is hydraulic and pneumatic system design going, and where should the emphasis be in component development?

Last June executive editor Allan Morris started out to find the answers . . .

. . . ***TRAVELED TO ILLINOIS*** . . . The first travel swing was through the Chicago-Peoria area where many earth moving equipment and industrial lift truck manufacturers were contacted. Results of the first interviews were extremely encouraging. Designers had very definite ideas on what they wanted and needed, and they were more than willing to talk about their problems; how they'd solved some and were working on others. As the project progressed, we noted certain patterns forming. We could see comparisons between design problems of similar equipment, as well as very different equipment. A pump mounting problem on a front-end loader might have been solved by a mining machine designer. Perhaps the filter on a road roller was the answer to the problem on a back-hoe. . .

. . . ***INTO OHIO*** . . . More of the construction equipment designers were interviewed on a trip through western Ohio—Bucyrus, Galion, Marion, Lima, and Findlay. To meet the engineers working on mining machines, we traveled through western Pennsylvania, visited a mine near Pittsburgh to get the maintenance viewpoint, and then wound our way through the hills of West Virginia. We ended up with notebooks full of ideas, as well as photographs of machines and the people who designed them. The job of putting all this together and presenting it was staggering but fascinating. . .

. . . ***THANKS*** . . . We think we've come up with a valuable package of ideas, and we hope it will stimulate still more ideas. Much of the credit is due to the men whom we visited. They took time from busy schedules to spend as much as a full day with us, and we want to thank all who participated in this project. Also we'd like to invite those we could not contact, as well as component manufacturers, to send us their comments.

Rubber Bonded-to-Metal Parts

Precision know-how, care, and special bonding techniques assure you of parts that will reduce assembly costs, improve product operation and simplify design.

Just send your problems—your blueprints to Precision for solution. Our engineering staff will be glad to make recommendations and quote to your requirements.

Specify Precision — first in quality

Precision Rubber Products Corporation

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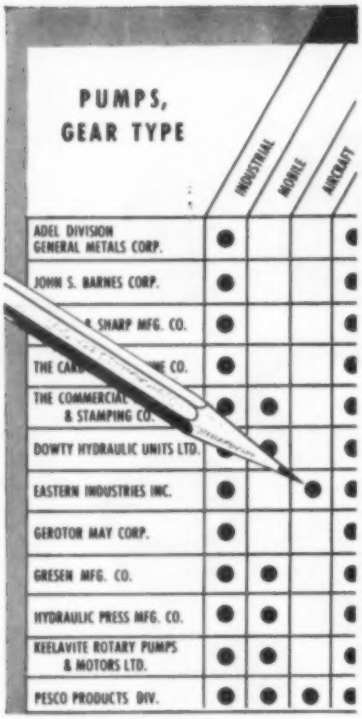

Quick with the answers . . .

• • • that's the Designers' Guide Issue of APPLIED HYDRAULICS in January. It provides 34 Quick Guides to Product Selection to help hydraulic design engineers choose fluid power components . . . and a Fluid Power Products Review to help engineers develop new equipment. Make sure your copy is handy!

January Issue

APPLIED HYDRAULICS

Order Extra Copies Now!

Last year many readers who wanted additional copies couldn't be supplied because the extra run was bought up within six weeks after publication. Now's your chance to make sure of getting extra copies. Price per single copy is $1.00. In quantities: 25 to 49 copies 75c each; 50 or more copies 40c each.

Send your order to:

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812 Huron Rd. Cleveland, Ohio

Fluid Power Lines

continued

CRITICIZES NCIH . . . In the Letters to the Editor columns this month we've published a letter from a very capable engineer and business executive who attended the recent National Conference on Industrial Hydraulics. His comments warrant serious consideration from the men who plan the Conference. NCIH is the only national technical program on fluid power. The 14th annual meeting will be held next year. Perhaps it's time for a hard look at the format and greater direct interest from industry in the content of the program.

FLUID POWER AT ITS BEST . . . Irving B. Hexter (right), president of the Industrial Publishing Corporation, was presented with a 1957 Gold Heart Award by Dr. Edgar V. Allen, president of the American Heart Association. Hexter was cited as "a man of courage, wisdom and vision" and "as the chief architect in our Heart Sunday concept". Mr. Hexter, the citation concludes, "has been a continuing source of inspiration and strength to all who seek the conquest of heart disease".

INDUSTRY AND GOVERNMENT . . . Recently we interviewed Jim Anderson, Chief of the Commerce Department's Business & Defense Services Administration. He brought us up-to-date on the Fluid Power Advisory Committee. You'll find this report in the Briefs columns. An important step will be taken with a survey early next year. It's designed to maintain production and meet user demands for fluid power components during any emergency. The cooperation of industry and government through BDSA can pay important dividends to suppliers and users.

MORE DOLLARS IN '58 . . . Here's a sure way to increase your income in 1958—enter an article on hydraulics or pneumatics in the 1958 Fluid Power Prize Paper Contest. Look at page 26 to learn how to enter and see what you can win in dollars. Put your sights on that $500 award. Writing about the work you know best can insure a bonus for your wife in 1958.

WEBSTER'S NEW PILOT OPERATED RELIEF VALVE

Compact design adapts to "tight" installations. Adjustable from 500 to 2000 psi. Maximum capacity, 20 gpm.

BOOSTS WORK OUTPUT 38.5%!

call the man from Webster

His intimate knowledge of this new relief valve — its many benefits and applications — can help in adapting it to your product.

Full speed power up to 93% of relief setting is now possible with this new Webster pilot operated relief valve. Result: 38.5% work bonus over "brute-force" type valves! More, you get all the benefits of clog-free performance, quieter operation...lower price. Mighty sound reasons for specifying Webster's pilot operated relief valve *now*.

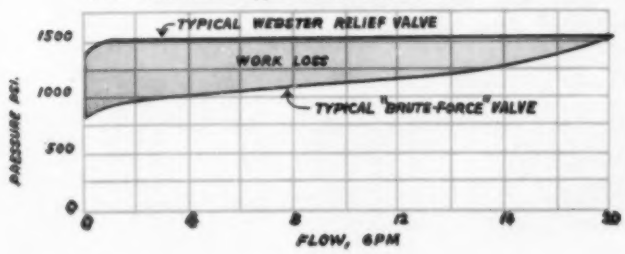
OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

MELROSE 3-3511

RACINE · WIS

Typical performance curve shows minimum pressure drop and instantaneous response of Webster pilot operated relief valve over "brute-force" type. 38.5% work bonus!



- ☐ *Have THE MAN FROM WEBSTER contact us—*
  —Please send the following:
- ☐ *Bulletin H3A2 covering the new Webster pilot operated relief valve*
- ☐ *Complete hydraulic catalog of pumps, valves and fluid motors*
- ☐ *New information or data as published*

Name_____

Title_____

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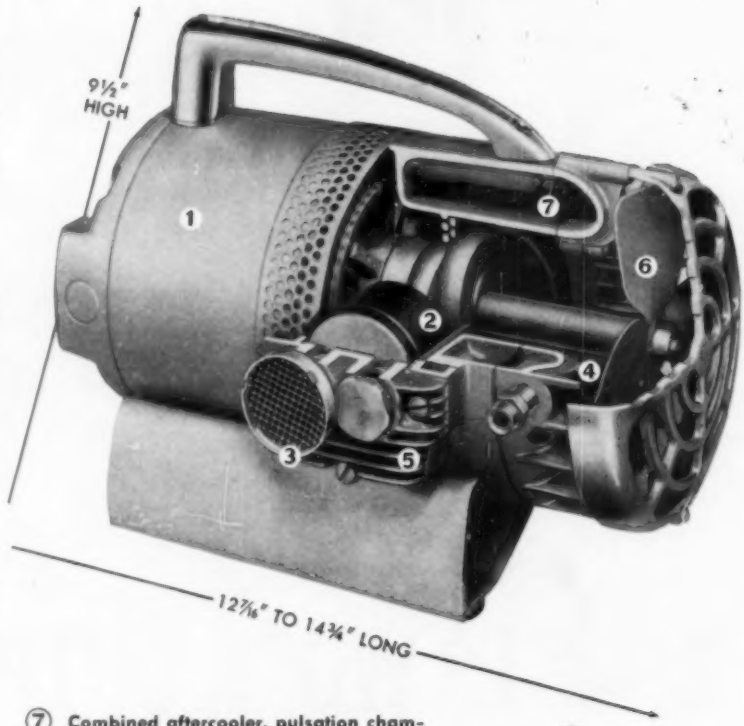
City_____ State_____

franklin adv. H104

Oil-Free COMPRESSED AIR

from a portable or built-in unit

No more oil-spoiled work! Here is a compressor which doesn't require lubrication of any kind—eliminates an oil separator, *ends expensive lubrication maintenance!* Whether your need is for a portable or built-in source of compressed air, the compact, lightweight B&G Oil-less Compressor assures cleaner, cooler, drier air and smoother operation.



① **Specially designed motors.** Built by B&G—noted for dependabi i ity. Ball bearings are *permanently* grease packed.

② **Graphite piston rings and skirts.** Made of a special composition which does not need lubrication. Operate for years without destroying the mirror-finish of the cylinder walls. Piston ring joints are self-sealing—reduce blow-by to a minimum.

③ **Dry valve construction.** Inlet and exhaust valves are positive-sealing without presence of oil. Precision lapped—self-cleaning—no rubbing parts.

④ **Safety valve.** (Not visible.) Provides constant bleed-off at maximum pressure. Also acts as automatic moisture drain.

⑤ **Bi-metal cylinder head.** Deep-finned aluminum head transfers heat faster. It is cast around the cast iron cylinder, making a leak-proof shrink-fit...no gasket needed.

⑥ **Blast cooled.** The fan blasts great volumes of air over the pulsation chamber, connecting rods, bearings, cylinders and motor. Low temperature operation assures higher efficiency, longer life.

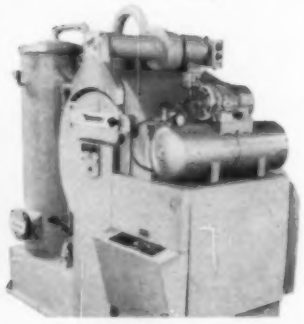
⑦ **Combined aftercooler, pulsation chamber, moisture separator.** Cooler, drier air is delivered at smooth, uniform pressure because of this integrated design.

For complete information on B&G Oil-less Compressors and Vacuum Pumps, send for Catalog GO-1156

Cart mounted B&G Air Compressor

B&G "Duplex Unit" mounted on horizontal tank

New type air stapler with air supplied by B&G Compressor



B&G Compressor built into dry cleaning machine

Oil-less AIR COMPRESSORS

BELL & GOSSETT COMPANY

Dept. FB-66, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Dr., Toronto 16, Ont.

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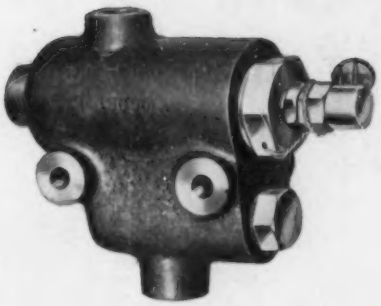
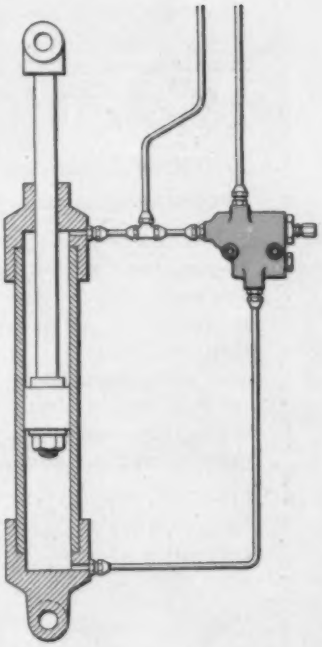
CIRCLE 15 →

BACKED BY A QUARTER OF A CENTURY OF LOCKHEED HIGH-PRECISION HYDRAULICS

The LOCKHEED *'Hydroloc'* VALVE

locks a hydraulic slave unit securely in any position without line pressure





This simple and effective unit creates a hydraulic lock in one end of the slave cylinder until the other end is fed under pressure, when the 'lock' is automatically released. Even if the slave cylinder is released under a heavy reactive load, the 'Hydroloc' prevents judder.

The 'Hydroloc' is simple, very easy to install, and needs no mechanical connections. If the load is always 'one-way' such as in a slave cylinder with a spring-loaded return, one single-type 'Hydroloc' is sufficient. If the load changes direction, the twin 'Hydroloc' valves, or two single valves, hold the piston in both directions.

'Hydrolocs' are available immediately in ¼" B.S.P. and for pressures up to 2000 p.s.i.

For further details of this and other Lockheed industrial units, please write for pamphlets and kindly mention this journal.

AUTOMOTIVE PRODUCTS COMPANY LIMITED
Shaw Road, Speke, Liverpool, England—Telephone Hunts Cross 2121

Lockheed

REGD TRADE MARK

INDUSTRIAL HYDRAULICS

COMPLETE INSTALLATIONS BRITISH MADE OR INDIVIDUAL UNITS

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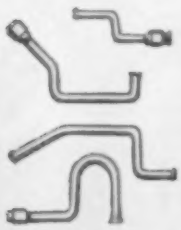
It's a known fact that many leading Original Equipment Manufacturers submit their original specifications for their *first* quotation to Eastman.

EASTMAN's unequalled experience in hydraulic conversion, plus many original designs shown in a few popular Eastman fittings at the right—give your product an appearance of quality that improves its competitive position in your field. It's a mark of distinction to be Eastman equipped!

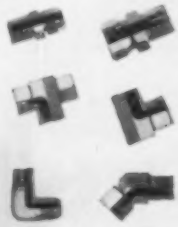
EASTMAN Engineering Service . . . Backed by Unequalled Experience

It is also a known fact that Eastman's co-operative engineering counsel and service is highly respected and often requested by leading OEM's. Let Eastman engineers help you lay out your fluid power lines—from pump to point of work—effecting economies in design, improving performance and increasing user satisfaction.

Let EASTMAN recommend the *best assembly . . . for the best performance . . . at the lowest cost.*

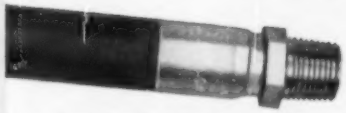


Bent Tubing with the necessary fittings to meet your own specific requirements.



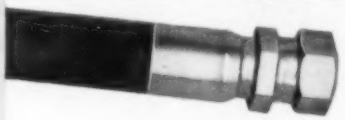
Adapters, Adapter Unions and Boss "O" Ring Fittings. All types and sizes available.

A COMPLETE LINE OF HYDRAULIC FITTINGS and HOSE ASSEMBLIES . . .



Permanently Attached Male (NPTF) for 1, 2 and 3 wire braid rubber cover hose, and 4 spiral wire extra high pressure hose.
Sizes: 3/16" thru 3".
Wkg. pressure: 375—5000 p.s.i.

Permanently Attached Male Flare (JIC) for 1, 2 and 3 wire braid rubber cover hose.
Sizes: 3/16" thru 2".
Wkg. pressure: 375—5000 p.s.i.

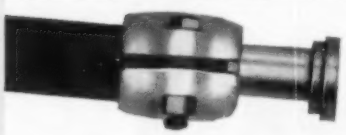


Permanently Attached Swivel Female for 1, 2 and 3 wire braid rubber cover hose.
Sizes: 3/16" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Reusable Male (NPTF) for rubber and cotton cover hose.
Sizes: 3/16" thru 1 13/16".
Wkg. pressure: 375—5000 p.s.i.

Reusable Swivel Female for rubber and cotton cover hose.
Sizes: 3/16" thru 1 13/16".
Wkg. pressure: 375—5000 p.s.i.

Permanently Attached Flanged Head Couplings for 1 and 2 wire braid rubber cover hose.
Sizes: 1/4" thru 2".
Wkg. pressure: 375—5000 p.s.i.



Clamp Type Coupling with split flange stems for 1 and 2 wire braid rubber cover hose.
Sizes: 1/4" thru 2".
Wkg. pressure: 375—5000 p.s.i.

Power Steering Assemblies to meet all your requirements.

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ENGINEERS:
Write for Technical Bulletin 200 for Complete Information and Data on Fluid Power Lines.

LETTERS to the editor

Address your letters to: Editor, APPLIED HYDRAULICS Magazine, 812 Huron Rd., Cleveland 15, Ohio.

Prize Papers

I should appreciate receiving two copies of the first award paper by Mr. Jack Bendror and also of the paper presented by Mr. Bruce Barton and Mr. Robert Gignac who received the 4th prize award.

Referring to the first award paper, please be informed that the modified cylinder and valve are a modification of our Valve Patent #2,722,946 and the cylinder is a modification of our Patent #2,534,292.

OTTO MUELLER
Mueller Engineering Co.
Dearborn, Mich.

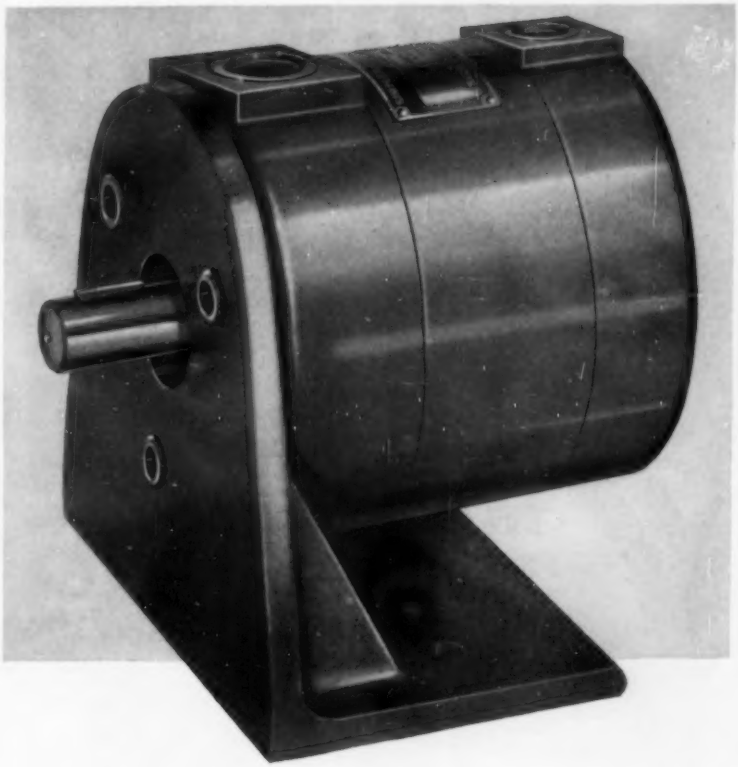
We are sending you tearsheets of the article by Jack Bendror. A copy of the article by Bruce Barton and Robert Gignac will not be available until publication.

Criticizes NCIH Program

I have written to Ralph King, Director of the National Conference on Industrial Hydraulics to express my disappointment in the recent program. Because APPLIED HYDRAULICS is the "sounding board" for those using fluid power, my letter may evoke further comments which could serve to improve this annual conference.

I travelled from Pittsburgh to attend this conference, my first, and feel that the selection of the technical content of the opening session was entirely wrong. True, the use of digital computers is not an uninteresting topic, but it certainly had no place in this meeting. The first two speakers began their talk by telling the audience that what they were about to say had nothing to do with the field of industrial hydraulics. The third speaker, opened with an equally shocking statement by saying that he had no fear in confronting the

Continued on page 16



SIMPLE DESIGN = LOW COST

This SECO radial-piston hydraulic pump provides the high performance characteristics of the piston-type pump at a price usually associated only with pumps of vane or gear design. If you use vane or gear pumps because of *price*, this SECO series "D" pump will give you more for your money.

The Model D-5 pump illustrated is rated at 2000 PSI maximum – 5 GPM – at 1800 R.P.M. – using 235 SSU oil at 100°F. The over-all efficiency is above 90% for a wide range of operating conditions.

SECO FLUID POWER

SIMPLEX ENGINEERING CO.
Subsidiary of RACINE HYDRAULICS & MACHINERY, INC.
ZANESVILLE, OHIO

CIRCLE 95 ON READER SERVICE CARD

Typical of K-30 application is this two-piece sealing ring design with K-30 outer ring and cast iron or stainless steel inner.

Licks tough ring problems

Proven Applications

★ Non-Lubricated Compressors: air, nitrogen, oxygen, hydrogen and carbon dioxide.

★ Rotary Shaft Seals: corrosive and non-corrosive surface.

★ Miscellaneous: sealing rings wearing directly against aluminum cylinders, wear bushings, wear inserts, and plug-type pistons.

Wide Range of Sizes and Types

Koppers K-30 piston, wear and sealing rings may be made in all widths and diameters—for use with cast iron, stainless steel, aluminum or chromium-plated cylinders.

Radical, rugged Koppers K-30 gives you new operating economy and long-lived performance in applications too tough for ordinary piston and sealing ring materials. K-30, a special compound of TEFLON* with other wear-resisting materials, features:

★ *Low friction coefficient* – inhibits ring wear.

★ *Self-lubrication* – reduces cylinder wear.

★ *Zero water absorption* – means that it cannot swell or change its shape.

★ *Temperature resistance* – from a molecular structure that permits operation at temperatures from – 350° F. to 500° F.

★ *Toughness and flexibility* – eliminate breakage, scoring and other damage caused by storing, handling, installing or servicing. Permit smaller ring cross-sections and smaller piston sizes and weights.

★ *Chemical inertness* – makes K-30 corrosion-proof.

If you have a ring problem, put Koppers to work on it. Contact your nearest Koppers Representative or write KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 1512 Scott St., Baltimore 3, Md.

*TEFLON—trademark of E. I. DuPont de Nemours & Co. for tetrafluoroethylene resin.

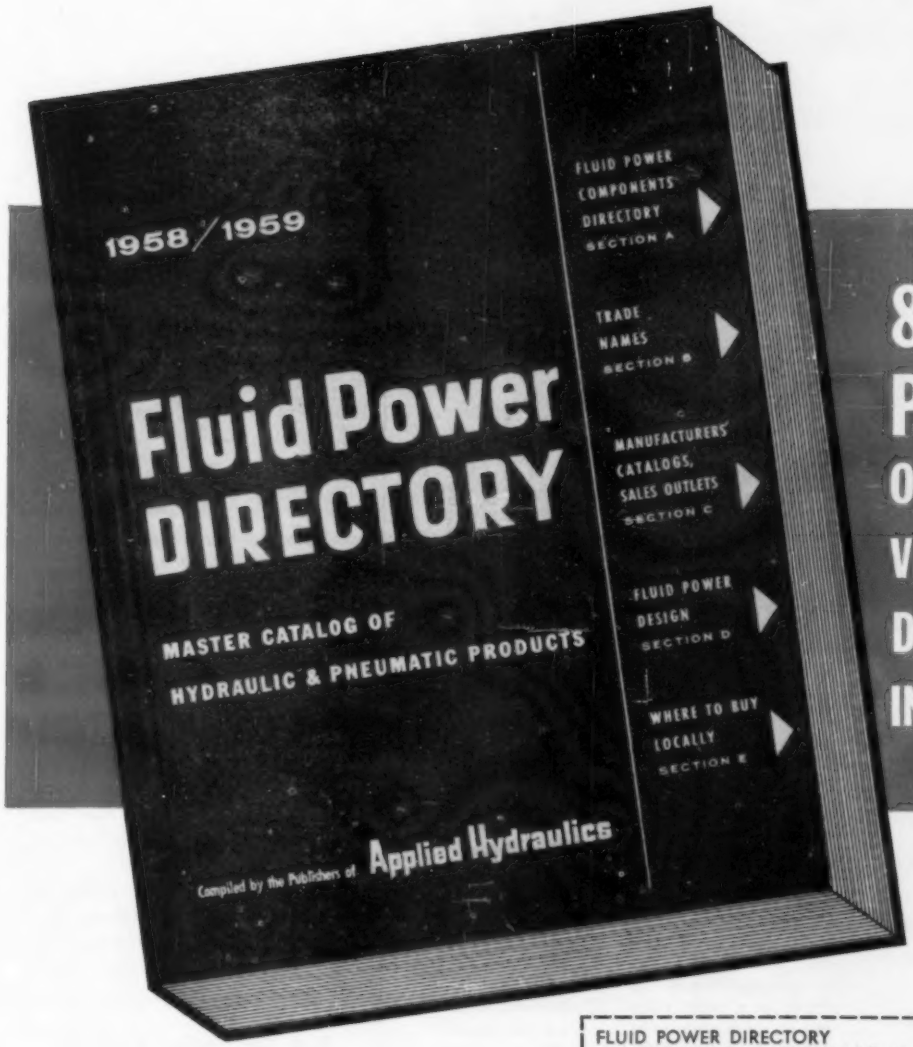
KOPPERS

INDUSTRIAL PISTON AND SEALING RINGS

Engineered Products Sold with *Service*

COMPLETE GUIDE

TO FLUID POWER . . . *helps you design and use oil and air circuits.*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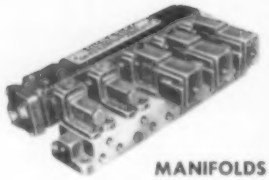
Specify **NUMATICS VALVES**
... there are no "equivalents"



MANIFOLDS

DSA34 valves mount interchangeably with all other SA Series air valves on Numatics air and conduit manifolds.

LINE VALVES

Numatics makes a complete line of foot-mounted, line-mounted 2- and 3-way valves, too. Ask for Bulletin #4000.

Today's control demands, particularly in automation applications, require a host of unusual air circuits . . . emergency stop inching circuits, dumping both ends of cylinder to exhaust, pressurizing both cylinder ports, to mention a few. The valves for jobs like these? Numatics spring-centered DSA34 valves . . . the valve series that gives you split-second response, takes pressure surges without sticking or fluttering. Numatics DSA34 valves are offered, what's more, in a wider variety of sizes and actions than any similar valves now on the market. Want more details? Send for Numatics new Bulletin #558A on unusual circuits using 3-position valves.

NUMATICS, Inc.

HIGHLAND, MICHIGAN Dept. AH

LETTERS to the editor

group because what he had to say would be over the heads of many of us so that we would not know if he was presenting factual data, and that to a great majority of the rest of the group, what he had to say would be "old hat" so that they would be bored and probably fall asleep. On the basis of these opening remarks it certainly would seem evident that I would ask myself, "Why should I bother to listen to this man?"

It appeared to me, at this conference, ideas are not exchanged. It is only a wonderful opportunity for salesmen to make new contacts with users of equipment.

L. ARTHUR LASSMAN
Benjamin Lassman & Son
Glenshaw, Pa.

Wants NCIH Papers

With regard to the papers presented at the 1957 session of the NCIH, we would be pleased to hear how we may obtain individual copies, as well as the bound volume, which, it seems, will be made available early in 1958.

FRANK RITCHIE
Test Supervisor
Jarry Hydraulics
Montreal, Canada

At the present time the only way you can get individual copies is to write directly to the authors. Bound copies will be completed, probably in March of 1958. *We do not print these proceedings—they are published by the National Conference on Industrial Hydraulics. You can place your order with Mr. Raymond Meade,* 3300 *South Federal Street, Illinois Institute of Technology, Chicago, Ill. In previous years price per copy was* $5.00.

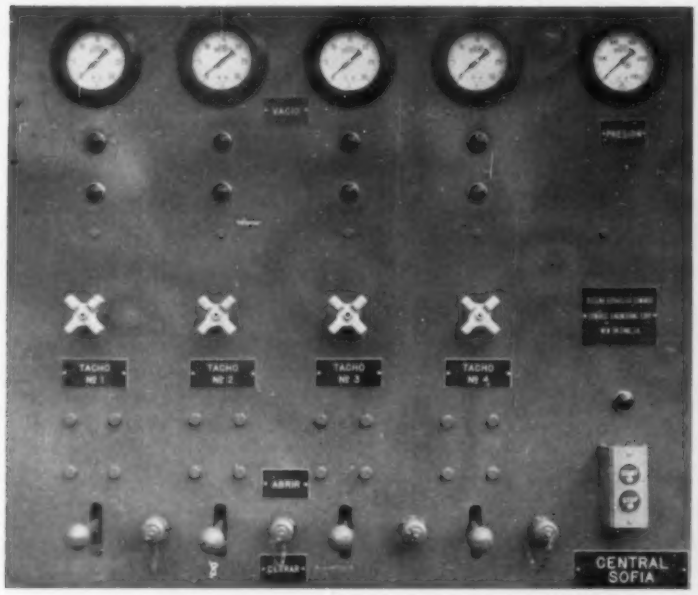
Has Cushioning Problem

Between one and two years ago an article dealing with hydraulic or pneumatic cushioning applied to a traveling cut-off knife was written up in your magazine.

We have a cut-off giving us a great deal of trouble and this article was referred to us as a possible means of eliminating the

Continued on page 18

Edwards Hydraulic
Control Systems and Pump Units



Edwards System for Remote Hydraulic Control of Valves

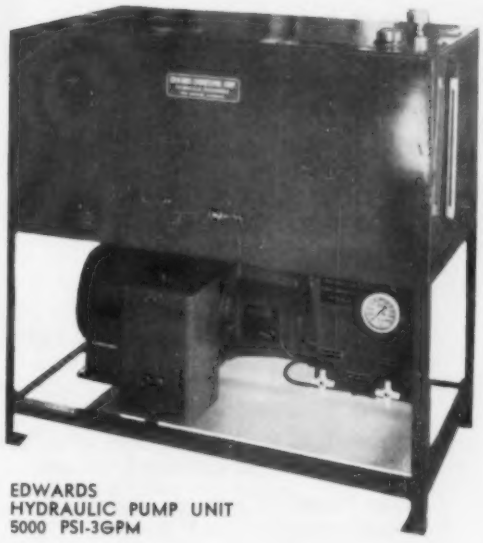
Edwards 5000 psi Dual Type Hand Pump Unit

We're specialists in the design and manufacture of hydraulic control systems and power units. Emphasizing system simplicity and quality equipment results in uninterrupted, reliable service.

We have built and are building hydraulic equipment for industrial, agricultural and marine fields.

Write us about your requirements for pump units, control panels and systems. Let us show you how Edwards' design and quality assures continuous, trouble-free operation of oil powered equipment.

Design, manufacture, repair and testing of hydraulic components and systems.



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HYDRAULIC PUMP UNIT
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a wide range of sizes engineered for optimum efficiency. *Graded Density* wool and cellulose types and porous metal elements for maximum protection.

CUNO HOUSINGS—

a complete line of standard and special models designed to handle all Cuno Cartridges.

Cuno Filters are filtration engineered for a wide range of requirements from 5 to 75 microns.

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LETTERS to the editor

condition. It consisted of an orificed bleed from the cylinder which decelerated the knife.

We shall appreciate a reprint or copy of the article if you have one available.

PAUL R. FRANZEN
Mechanical Engineer
The Richardson Company
Melrose Park, Illinois

APPLIED HYDRAULICS *has published a number of articles over the years offering solutions for cushioning hydraulically and pneumatically actuated operations. We don't know specifically what article you were referred to. An article published in* 1956 *showed how accumulators were used to eliminate the bounce on a traveling cut-off knive on a plastic cutting operation. Tear-sheets of this article have been sent you.*

Pulsating Power

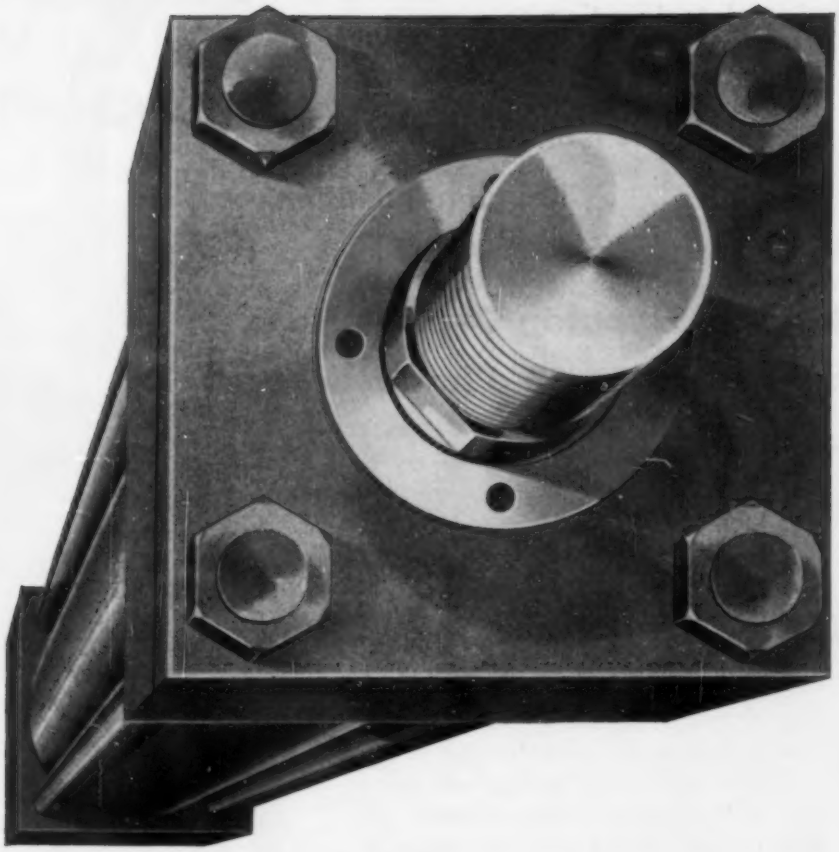
Would you please advise whether there is available a pulsating hydraulic unit for oil which controls delivered power through a control, valve or pump. This should be a riveting, pounding or pulsating action rather than a continuous or steady flow.

We are not certain whether such a product is available, however, it has been brought to our attention that recent issues of APPLIED HYDRAULICS had featured stories relevant to this.

JOHN J. JAROCKI
Purchasing Department
Westinghouse Electric Corp.
Sharon, Penna.

There are a number of ways in which a variable displacement pump or hydraulic control valve can be rapidly shifted to give a resulting pulsating flow of oil. Valves or pump control can be actuated electrically through solenoids or pilot-operated devices to get any sequence of hydraulic flow that may be desired. Systems for arranging intermittent flows are very common and engineers working with hydraulic systems have a wide variety of choice in control. ▼▼▼

AT YOUR REQUEST...



ANKER-HOLTH

Hydraulic Cylinders now available in Square Head design

Positive Trouble-free Performance

Anker-Holth Division, for 18 years designers and manufacturers of quality air and hydraulic power cylinders, now offers a standard line of all steel, high pressure square head tie rod cylinders. Important new operating features and design achievements assure positive controlled power for a wide range of industrial applications.

Standardized Mountings for Interchangeability

Conservatively rated at 2000 P.S.I. working pressure and 3000 P.S.I. non-shock pressure every cylinder is proof tested at 4500 P.S.I. All mountings are available, standard bores from 1½ to 8 inches. Standardized mountings provide complete interchangeability with most makes of square head cylinders. The Anker-Holth "□" line meets all J.I.C. specifications.

For more information contact your local Anker-Holth representative or Anker-Holth Division, Port Huron, Michigan. YUkon 5-7181

ANKER-HOLTH DIVISION
THE WELLMAN ENGINEERING COMPANY
2723 CONNOR STREET, PORT HURON, MICH., U. S. A.

CIRCLE 9 ON READER SERVICE CARD

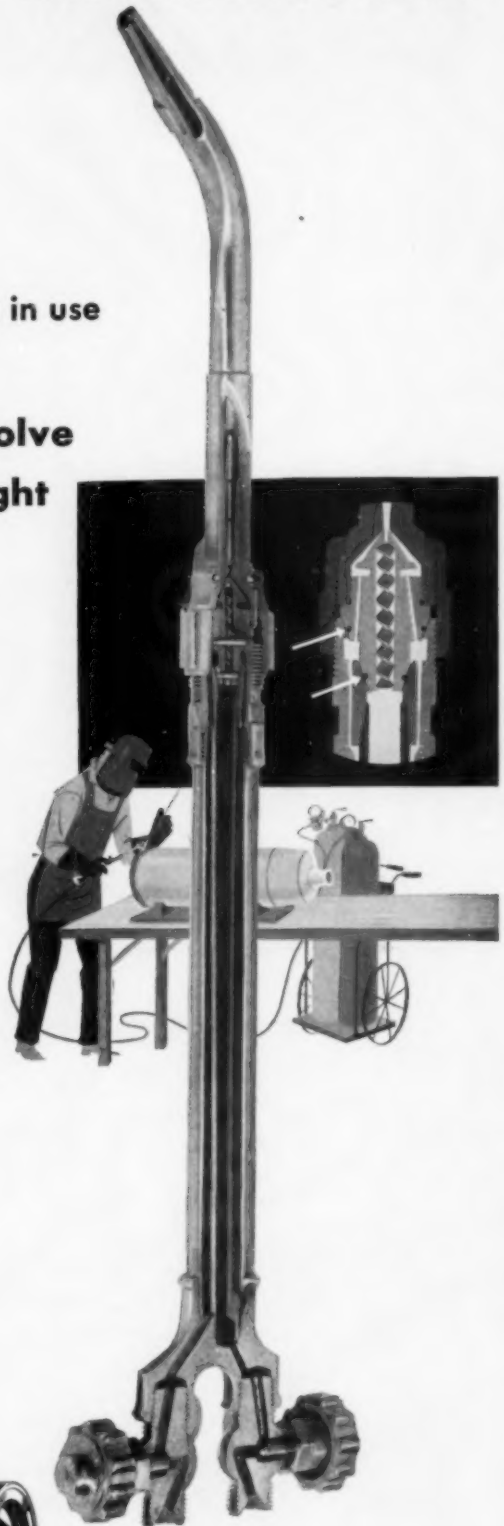
Ozone deterioration

Continuing stress

Gas leakage

Rough handling in use

New National Hypalon O-rings solve these problems; insure a hand-tight gas seal in Victor Torches



As static seals, commercial Buna N O-rings performed satisfactorily in Victor welding torches — *when the rings were new.*

However, ordinary O-rings age fast in welding torches. They receive rough treatment when welders change nozzles; nozzles are often dropped on the ground to lie there until needed again. Severe ozone deterioration is experienced. Continuing stress, although mild, impairs O-ring elasticity. Rings on welding nozzles are sometimes subjected to long shelf life.

National Seal engineers developed a new O-ring compound, National Hypalon L-11, which not only withstands rough handling, ozone deterioration and stress but exhibits many times the shelf life of Buna N compounds previously used. Today, National Hypalon is standard at Victor.

Special compounding to meet unusual conditions is a basic part of National's complete O-ring engineering service — service available from National Field Engineers in major cities nationwide.

NATIONAL SEAL
Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

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CIRCLE 69 ON READER SERVICE CARD

ANNOUNCING!

VICKERS® New ¼" Temperature and Pressure Compensated FLOW CONTROL VALVE

ANOTHER VICKERS FIRST

FOR OPERATING PRESSURES UP TO 2000 psi

For years the Machine Tool Industry has been asking for a combination Temperature and Pressure Compensated Flow Control Valve to insure CONSTANT FEED RATES. Now for the first time it is available as a production unit at a reasonable price.

Check THESE EXCLUSIVE FEATURES that mean Optimum Tool Life and Better Work Finish:

☑ **TEMPERATURE COMPENSATED**
Constant feed rates all day long with same throttle setting because throttle automatically compensates for changes in oil temperature. The compensator mechanism is simple in design and durable.

☑ **PRESSURE COMPENSATED**
Constant feed rate throughout entire cycle because built-in pressure hydrostat automatically compensates for load changes.

☑ **SINGLE THROTTLE COMPLETE RANGE ADJUSTMENT**
Greater flexibility because valve is adjustable within entire flow range of 5 to 1000 cubic inches per minute.

☑ **REVERSE FREE FLOW AS STANDARD FEATURE**
A standard feature which permits reverse free flow (up to 1400 cu. in. per min.) from outlet to inlet port by-passing control elements.

☑ **TAMPER-PROOF ADJUSTMENT**
Retension of original feed rate is assured because a set screw prevents inadvertent throttle movement and a cover over the set screw can be locked in place.

☑ **INTERCHANGEABLE**
This new valve replaces 12 previous models and it is interchangeable with all of them, also the drain connection is eliminated on the new valve to simplify piping.

☑ **GREATER ECONOMY**
No need to stock several valves for wide range of flow rates. Drain connection is eliminated, piping costs are reduced.

☑ **MAXIMUM RELIABILITY AND ACCURACY**
Design of temperature and pressure control components assures maximum circuit reliability and extreme accuracy of feed through a range of 5 to 1000 cubic inches per minute.

FOR ADDITIONAL INFORMATION SEND FOR I-195040 7945

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DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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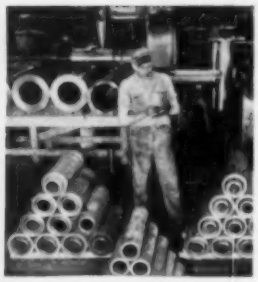

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Because Shenango tubular stock is *centrifugally* cast, impurities and pockets are *forced* out of the metal in the molten stage. Moreover the grain is finer, pressure-dense and more uniform. This results in smoother machining, better control, and less waste of time and metal.

Made of high-strength Meehanite metal or long-lasting bronze, Shenango tubular stock comes in a *complete* range of I.D. and O.D. sizes. Its lengths go up to 20 feet, depending on diameter, which keeps cut-off waste to a minimum.

While the demand for Shenango bar stock is largely tubular . . . solid round, square, hexagonal, rectangular and other special shapes are readily available.

It will pay you to specify Shenango bar stock for longer wear, greater strength, fewer rejects . . . and lower over-all cost. For full information, write to: *The Centrifugally Cast Products Division* of The Shenango Furnace Company, Dover, Ohio.

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MONEL METAL • NI-RESIST • MEEHANITE® METAL • ALLOY IRONS

Future Events

January 13-17, 1958: SAE Annual Meeting and Engineering Display, The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

January 27-30: Plant Maintenance & Engineering Show, International Amphitheatre, Chicago. For further information write Clapp & Poliak, 341 Madison Ave., New York 17.

January 28-31: 25th Annual Meeting of the Institute of the Aeronautical Sciences. Sheraton-Astor Hotel, New York, N.Y.

February 2-7: American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York. For additional information write to AIEE headquarters 33 W. 39th Street, New York 18, N. Y.

March 10-11: ASME Lubrication Division will sponsor a two-day symposium at 150 East 42nd Street, New York City. Subject to be discussed is "The Role of Viscosity in Lubrication."

March 31-April 2: SAE Production Meeting and Forum, The Drake, Chicago, Illinois.

April 8-11: SAE Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display. Hotel Commodore, New York, N.Y.

April 14-17: Design Engineering Show, International Amphitheatre, Chicago. Write Clapp & Poliak, 341 Madison Ave., New York 17, for further details.

May 1-8: ASTE Tool Show, Convention Center, Philadelphia, Pa. For complete information write ASTE, 10700 Puritan Ave., Detroit 38, Mich. ▼▼▼

IN FEBRUARY . . .

APPLIED HYDRAULICS will feature design of components, layout of circuits, and application of water hydraulic systems

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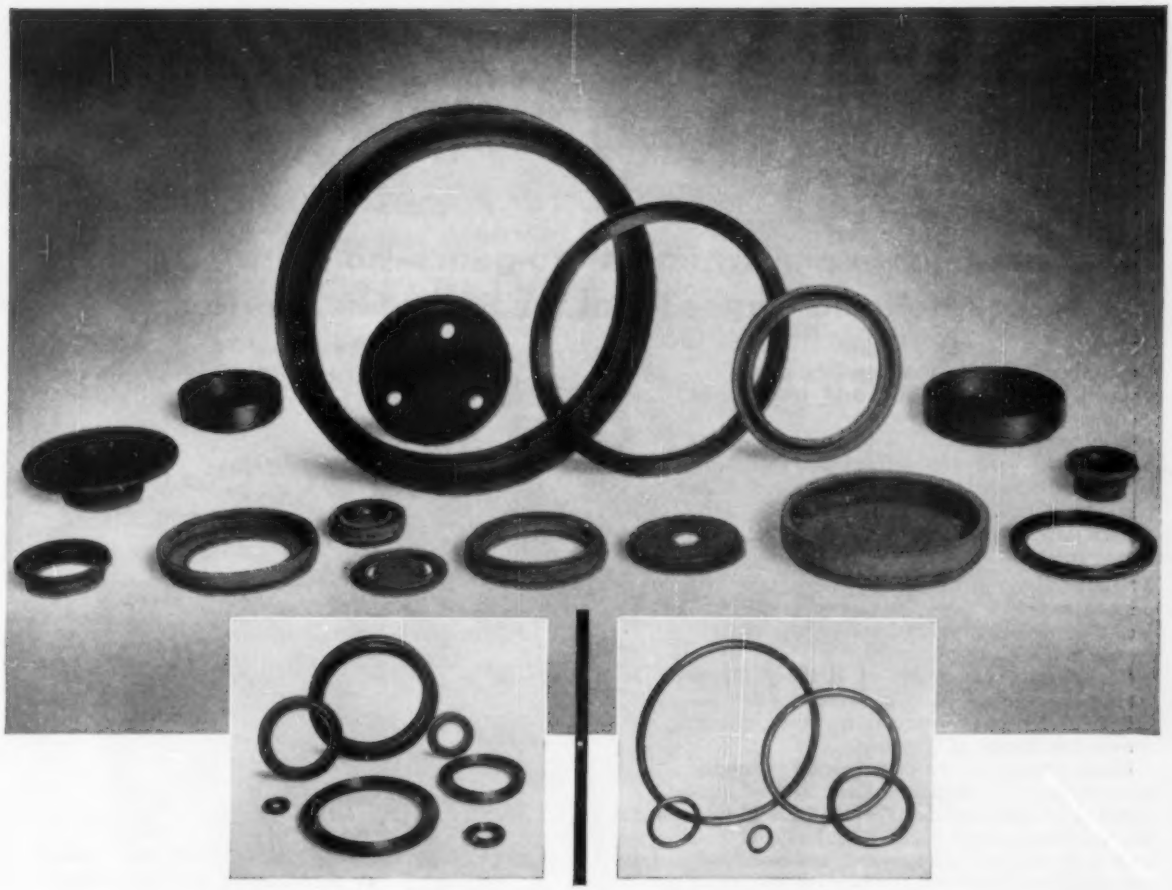

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SYNTHETIC packings by G & K bring to the industry a wide choice of materials offering distinct advantages. They offer unsurpassed, long-lasting performance in a great many applications where extreme conditions require a synthetic compound for practical solution. G & K is ready to supply your needs in synthetic rubber packings of all types, including a complete line of "O" rings.

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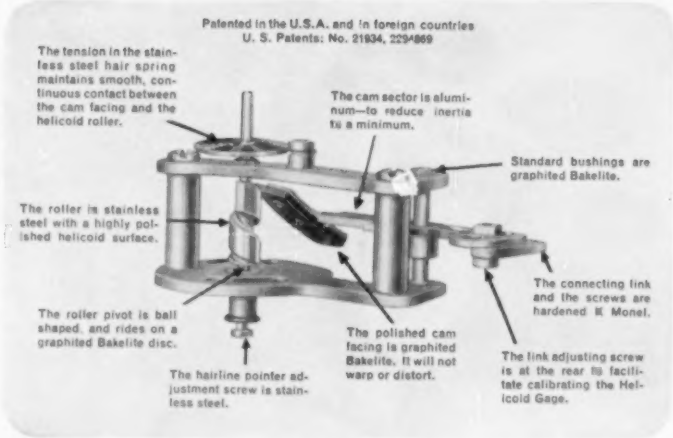
Shock-Proof Cam Actuation (no gears—no teeth) Makes Helicoid Gages Ideal for Hydraulic Services

Designed for pulsating and impact hydraulic service, the Helicoid movement releases at zero in the event of sudden pressure reduction. This eliminates shock on pointer and movement by reducing impact of pointer against pointer stop pin. This protects the gage mechanism where gages may be subject to occasional vacuum.

The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or certain severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown at the right.

Rolling action of the cam facing against the roller surface . . . graphited Bakelite bushings, roller pivot base and cam facing . . . K Monel connecting links and screws . . . all such Helicoid features protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation through millions of cycles.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The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
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The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

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(Patent pending)

This is a simple, effective throttling device to reduce or eliminate pulsations of the gage pointer. There are no moving parts, no adjustments needed. Available in three types in powdered bronze or stainless steel for air, gas, water, steam, medium or heavy liquids.

Enlarged cutaway view

Threaded cartridge body for assembly in any Helicoid Gage tapped socket shank

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Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

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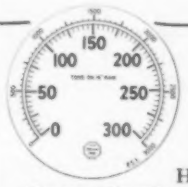
To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak nor crack.



DOUBLE SCALE DIAL SHOWS TONS ON RAM AND PSI

Helicoid Gage dials are supplied in jet black with white figure markings or in dull white with black figure markings. They are constructed of laminated phenol with a transparent plastic surface and the longest possible scale length for more accurate readings. They are non-corroding, will not discolor nor fade and will not crack, chip nor peel.

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Hard faced seats, in combination with precision finished, selectively hardened discs and wedges give these valves amazing resistance to erosion, corrosion and galling. That's why they are setting new standards of performance in steam, water, oil, or gas services at the recommended pressures and temperatures.

Get longer, drop-tight, service life with minimum maintenance by specifying Vogt G P Valves. Available in a complete range of sizes from 1/4" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

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for

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6th Annual Competition

First Prize $500

Second Prize $300

Third Prize $200

4th to 7th Prizes, each $50

All prize papers will be published in APPLIED HYDRAULICS Magazine. Papers receiving honorable mention awards will also be published during 1959 and paid for at regular rates.

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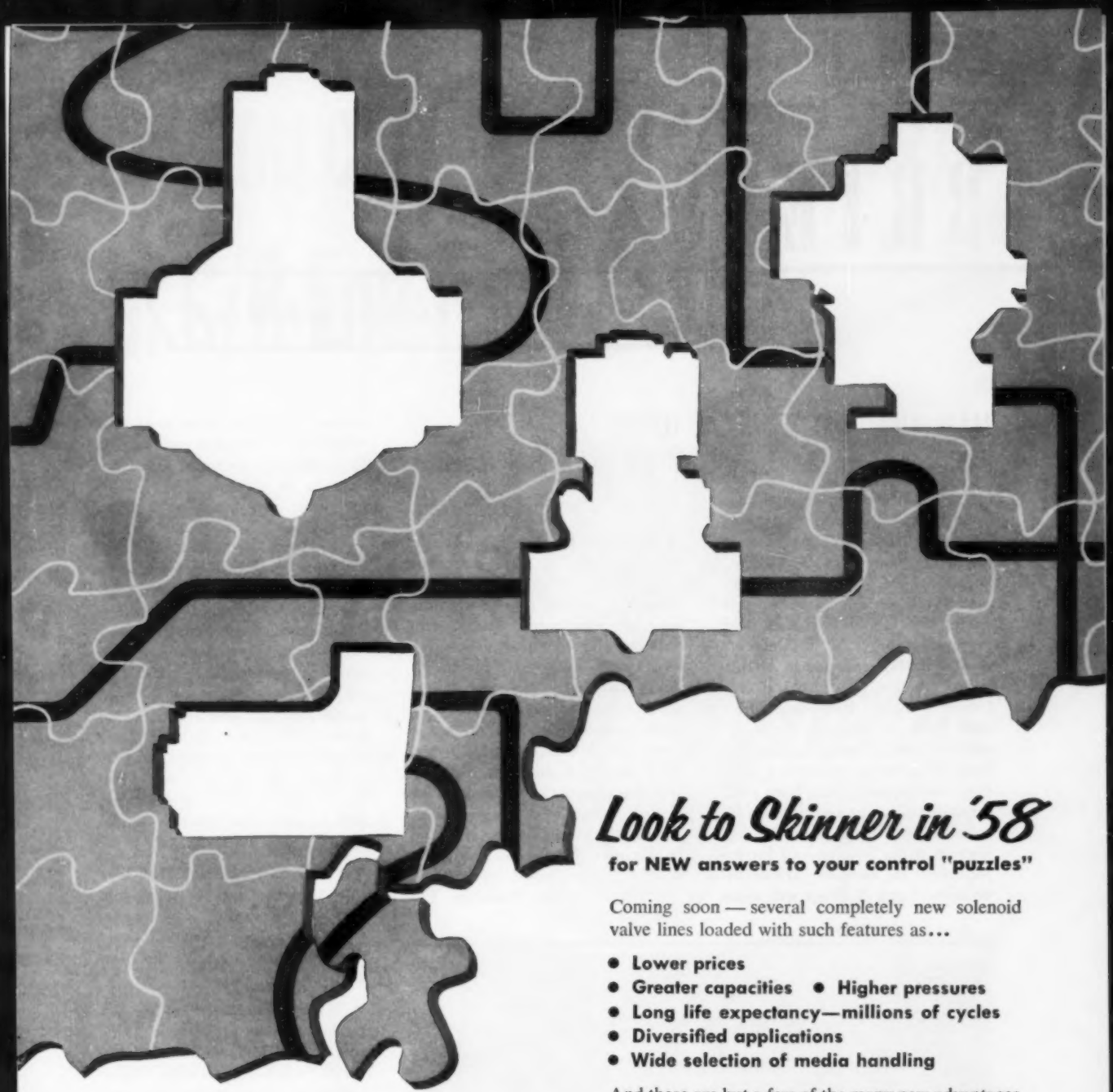

Look to Skinner in '58

for NEW answers to your control "puzzles"

Coming soon — several completely new solenoid valve lines loaded with such features as...

- **Lower prices**
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- **Long life expectancy—millions of cycles**
- **Diversified applications**
- **Wide selection of media handling**

And these are but a few of the many new advantages of Skinner's new solenoid valves. As always, of course, they'll be strictly manufactured to Skinner's highest-quality engineering standards.

Look for the announcements of Skinner's new valve lines in these pages throughout 1958. For advance information, write Dept. 31D.

Most important, these new valves will give you performance and applications that heretofore have not been possible !

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THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION

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BRIEFS about fluid power

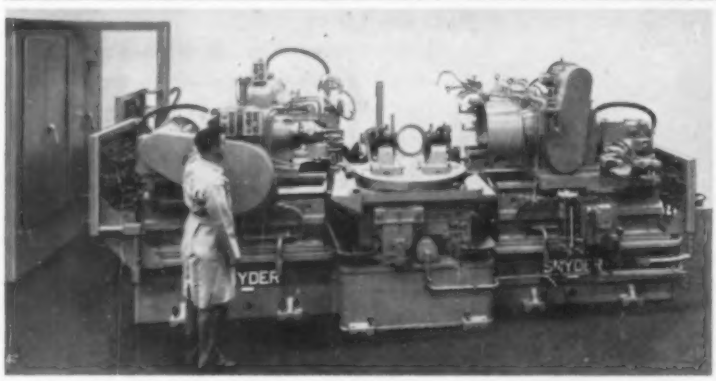
MARKETING AND TECHNICAL TOPICS . . . highlight NFPA Fall meeting

Programming of meetings held by the National Fluid Power Association is planned by three boards: marketing, management services, and technical. Each board presented speakers and discussions during the three day meeting held in Washington, D.C., in October.

• **Marketing**—Chairman of this board, Racine Hydraulics' v-p Henry Schultz first introduced Bob Firth of Electrol. Firth detailed a survey being handled by Ernst & Ernst to provide a running product sales chart from 1952 through 1956. The association's 66 members are being asked for figures on dollar volume and for information on sales to various industries. Ernst & Ernst will issue accumulative results when sufficient surveys are completed.

• **Warranties**—Bill Lockridge of New York Air Brake discussed warranties and recapped the results of a survey which tells how member companies handle warranties. Most companies do give warranties with their products. Most frequently the warranties, insuring against defects caused by poor workmanship and defective materials, are made for a period of 1 year after shipment. The survey was prepared only to share information, not to develop any uniformity in warranties.

• **Export Markets**—An excellent paper presented by Stephen W. Kann, editor, American Exporter, detailed four ways in which manufacturers can market their products overseas. These are through an exporter, establishing an export sales department, using a combination export manager or an export trade association. Under the classification of power transmission equipment which includes hydraulic and pneumatic units, government export figures show an increase from $11.7 to $25.1 millions between 1952 and 1956. Export sales result in more profit per unit cost compared to domestic sales: To sell more abroad these points must be stressed: delivery, product quality, foreign language instructions, and no substitutions—the model ordered must be sent.



This hydraulically-operated, electrically controlled, line-index type machine performs 40 separate machining operations, with pushbutton controls for indexing and rotating the fixture and cycling the machine heads. Separate hydraulic power packs provide power for operating the machine slide and index motions. Designed by Snyder Tool & Engineering Co., Detroit.

• **Sales Engineers**—What is a sales engineer, how to select him and how to pay him were the subjects of two papers and a panel discussion presented by the Marketing Board.

• **Management Services**—A public relations program is taking shape. Bob McCormick of Automatic Switch used a slide presentation to show methods of acquainting the public with fluid power. Material for schools, trade and consumer publications is planned.

"Creative thinking" was covered in a talk by RCA's C. M. Sinnett which analyzed the techniques of generating ideas.

• **Valve ratings**—One of the projects of the Technical Board is the establishment of uniform valve ratings. Allan Churchill of Auto-

Continued on page 30

Now you can get standard sizes in C/R End Face Seals!

Chicago Rawhide now announces the availability of a complete new line of Standard End Face Seals to meet the widest possible range of sealing requirements. For sizes or conditions beyond the range of Standard End Face Seals, C/R engineers will continue to cooperate with you on special designs. Their experience in sealing applications is unmatched — your assurance of getting the correct seal for the job.

Write for your free copy of this new C/R Bulletin →

Bulletin EF-100 includes complete envelope space data on C/R Standard End Face Seals and mating rings to help you select the correct size for your equipment design:

- Size range table in two series — long and short — from ¾ to 4 inch shaft diameter.
- Size range table on mating rings.
- Typical seal installations for internal and external pressure.
- Special instructions on how to order.

C/R
STANDARD
END FACE SEALS
maximum sealing efficiency in minimum space
• ¾ to 4 inch shaft sizes
• pressures to 500 psi.
• temperatures to 500° F.
• peripheral speeds to 15,000 FPM.
• external or internal pressures
2 complete series . . . long and short . . . pre-engineered to meet the widest possible range of sealing requirements. Standard mating rings also available.
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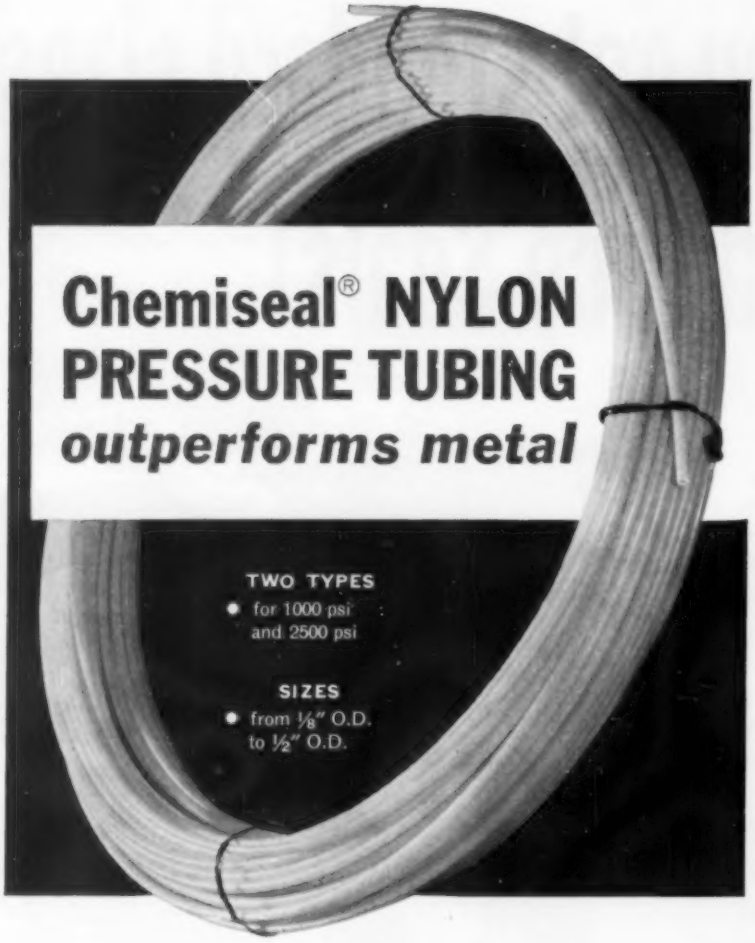
C/R PRODUCTS: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-Metallic Gears



Uses: For pressure lubrication lines, hydraulic and pneumatic systems, oil and fuel lines, chemical and food processing lines, vacuum system connections, etc.

Advantages: Handles high pressures at low cost. Long life under continuous flexing and vibration. Tough, abrasion resistant. Low minimum bend radius. Crush resistant—won't collapse. Inert to hydrocarbons, oils, greases, synthetic hydraulic fluids, most solvents and alkalis. Odorless, tasteless, non-toxic, fungus resistant. Wide service temperature range. Applicable to standard flare and flareless fittings. Easily cut, flared, installed around existing equipment, requiring no pre-bending, flexible couplings or intermediate fittings.

Product of U.S.G's new, ultra-modern Nylon-Teflon Extrusion Plant—new and exclusive techniques and facilities.

Write for further information.

United States Gasket Company
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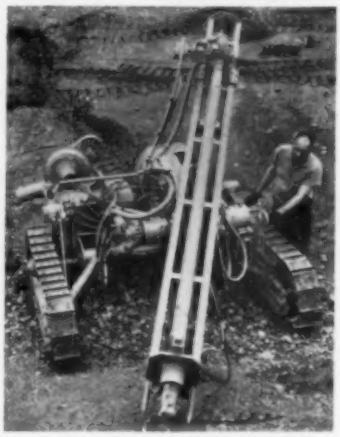
United States Gasket *Plastics Division*
OF THE GARLOCK PACKING COMPANY

BRIEFS continued

matic Switch told of the committee's study to come up with a valve sizing method which is understandable and acceptable to users and manufacturers. The committee's review of the National Bureau of Standards report 3683 issued October 1954 concludes that the method of rating valves as outlined in this report is too complex.

• **Fluids**—A new booklet on fire-resistant fluids is being prepared. It will include a specification sheet on all available fluids for hydraulic service.



This rock drilling machine uses a hydraulic motor to turn the bit at 60 rpm through a speed reducer with a 15:1 ratio. A hollow drive shaft permits an air cylinder to power the continuous hammering of the drill head. Reich Bros. Mfg. Co., Terre Haute, Ind., designed and built the unit.

A panel of eight men discussed the current status of hydraulic fluids. Paint, packings and price are problems confronting the user of fire-resistant fluids. Pump problems—cavitation, metal fatigue—are usually the result of incorrect suction characteristics. Fluids having a high specific gravity require special attention to pump suction head.

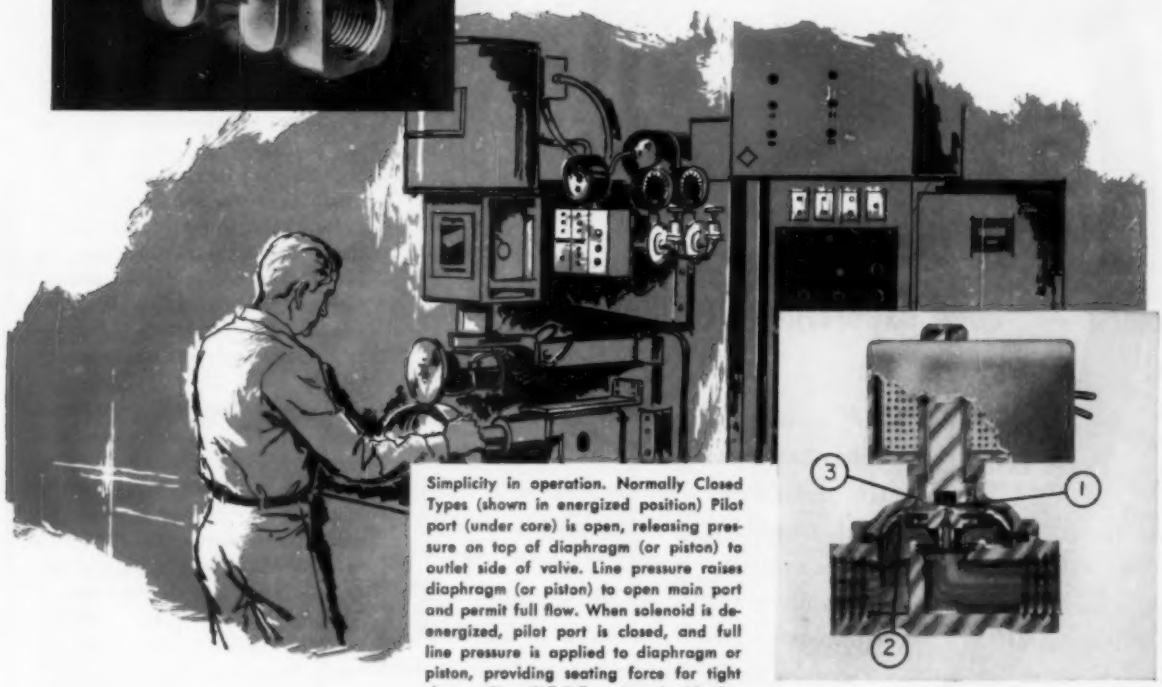
Speaking for a large user, Ward, Diehl, of General Motors, said that the solution to fluid problems would be water with soluble oil having a vapor phase and liquid phase inhibitor. "How

Continued on page 32

fast cycling ASCO solenoid valves operate 400 / minute in welding operation

If you have a flow-control problem that demands a high cycling rate, then the new line of ASCO 2-way solenoid valves offers a sound solution. These valves, Bulletin 8210A, are now available in a full range from ⅜ through 3 inches; pressures to 350 p.s.i.

In the ⅜ to ¾ inch sizes, cycling rates of 400 per minute are achieved; in the 1¼ to 3-inch sizes, 40 to 100 cycles, depending on size and service. These high cycling ratios are important reasons why many manufacturers of arc welding equipment today are specifying ASCO.



Simplicity in operation. Normally Closed Types (shown in energized position) Pilot port (under core) is open, releasing pressure on top of diaphragm (or piston) to outlet side of valve. Line pressure raises diaphragm (or piston) to open main port and permit full flow. When solenoid is de-energized, pilot port is closed, and full line pressure is applied to diaphragm or piston, providing seating force for tight closure. Sizes ⅜"–¾" equipped with diaphragm. Sizes 1¼"–3" equipped with piston.

The reason for this fast-action characteristic can be seen by checking a cross sectional view of the valve. Primarily it is due to large ratio of pilot seat area (1) to bleed area (2) (permitting rapid exhaust of pressure above the diaphragm) and small displacement volume (3) to be handled by pilot system on both diaphragm and piston (permitting rapid filling and exhausting of pressure above diaphragm or piston.)

Of course the dependability that is built into the entire ASCO line is to be found in the 8210A's. They have been rigorously test-proved well past 20 million cycles. In compactness, too, these 2-way valves offer a design plus. In the ⅜ – ½" sizes they measure only 2¾" face-to-face and 3-13/16" overall height.

Write for Catalog 201 covering complete line of ASCO solenoid valves

Automatic Switch Co.
50-B Hanover Road, Florham Park, New Jersey
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ASCO

When you buy
flexible connections . . .

get the benefit
solid experience provides

"Know-How" makes the big difference! The knowledge gained through half-a-century of continuous Research and Development is built into every FLEXON assembly . . . assuring you a product that gives superior service.

For your synthetic, plastic or metal hose requirements, find out what a difference Flexonics craftsmanship can make to you in fluid power or other applications. For specific recommendations send an outline of your requirements.

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BRIEFS / continued

about more water components?"

On the subject of packings, Parker-Hannifin's E. L. Carlotta pointed to the aniline point of an oil—its swell or shrink index—as most critical in the selection of a suitable packing compound. Proper compound selection requires knowledge of the application: speeds, temperatures pressures, cycling.

The potential of florinated polymers for higher temperatures was discussed by Chicago Rawhide's technical director, H. C. Crosland.

Harry F. King, Bureau of Ships, said more work is needed on synthetic fluids to define hydrolitic stability, to give bulk modulus data, to define thermal stability, to meet load carrying demands and wider temperature ranges, to resist nuclear radiation, and to provide oxidation stability in ozone rich atmospheres.

Hydraulic fluids of the future, the silicones, were discussed by W. H. Ragborg of Dow Corning. Chlorine containing silicones look promising as a solution to lubricity troubles with ferrous metals in sliding contact.

- **Terminology**—Walter Kudlahty of Flick-Reedy Corp. discussed a bulletin which is being circulated to obtain suggestions to improve the present glossary of fluid power terms.
- **Bore and rod sizes**—A survey is being sent to 190 cylinder manufacturers to obtain information on cylinder bore and rod sizes. Purpose of the survey is to obtain manufacturers preferences.
- **Symbols**—Drafting symbols for fluid power circuits have been completed by the American Standards Association. NFPA was among the many groups which cooperated in the preparation of the drawing standards.
- **SAE activity**—Kudlahty reported on work being carried on by SAE which directly relates to fluid power. Work is being done on modifying port chamfers to accommodate O-ring boss fitting as well as the metal-to-metal port fit-

Continued on page 36

CIRCLE 39 ON READER SERVICE CARD

CIRCLE 66

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Minneapolis—Miller Fluid Power Div., 2800 Foshay Tower. Phone Federal 5-0449

MISSOURI

St. Louis—Sturgis Equipment Co., 601 S. Taylor Ave. Phone Olive 2-5380

NEW YORK

New York City—C. H. Ribble Co., 31 Di Carolis Court, Hackensack, N. J. Phone Diamond 2-2602

Rochester—Miller Fluid Power Div., 114 Thistledown Dr. Phone Congress 6-1660 or Browning 1-2109

Buffalo—Miller Fluid Power Div., 28 Church St. Phone Madison 3993

OHIO

Akron-Youngstown—Miller Fluid Power Div., P. O. Box 150, Sebring, Ohio. Phone Sebring 8-6368

Cleveland—Miller Fluid Power Div., 12703 Triskett Rd. Phone Clearwater 2-3131

Dayton—K. C. Mosier Co., 628 Ludlow. Phone Michigan 9805

Columbus—K. C. Mosier Co., 549 N. Columbia. Phone Capital 1-7120

Lima—K. C. Mosier Co., 1566 N. Union. Phone 6-8616

Cincinnati—K. C. Mosier Co., 6119 Cary. Phone Garfield 1-1023

Toledo—J. N. Fauver Co., R.F.D. Dutch Road, Waterville, Ohio. Phone Waterville 3598

PENNSYLVANIA

Philadelphia—Miller Fluid Power Div., 1468 York Rd., Abington, Pa. Phone Turner 4-4905

Pittsburgh—Ralph Hiller Co., 4133 Brownville Rd. Phone Tuxedo 2-7353

TEXAS

Houston—Hydraquip Corp., 6645 Navigation Blvd. Phone Walnut 6-8301

Dallas—Hydraquip Corp. 349 Oaklawn Phone Lakeside 6-1742

WASHINGTON

Seattle—George W. Warden Co., 1305 Dexter Ave. Phone Alder 0622 or Adams 0150

WISCONSIN

Milwaukee—Fluid Power Equipment Co., 3320 Green Bay Ave. Phone Concord 4-0046

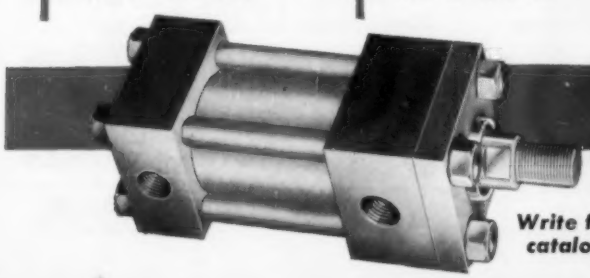
QUEBEC, CANADA

Montreal—Miller Fluid Power Div., 980 45th Ave., La Chine. Phone University 1-1304

ONTARIO, CANADA

Toronto—Miller Fluid Power Div., 4158 B. Dundas St., W. Phone Belmont 3-0831

Hamilton—Miller Fluid Power Div., 172 Blair Lane, Ancaster. Phone Jackson 9-5751



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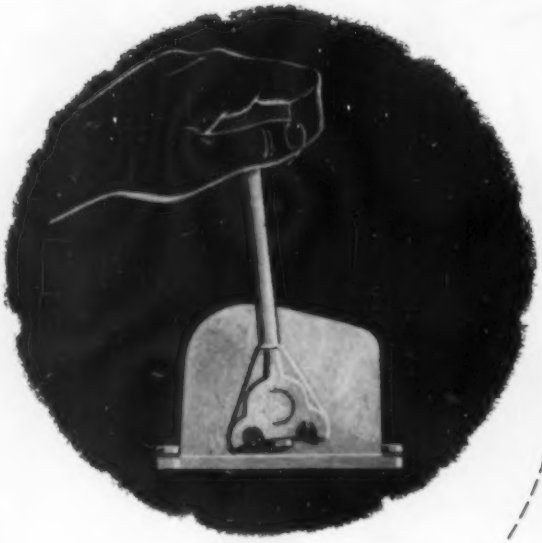

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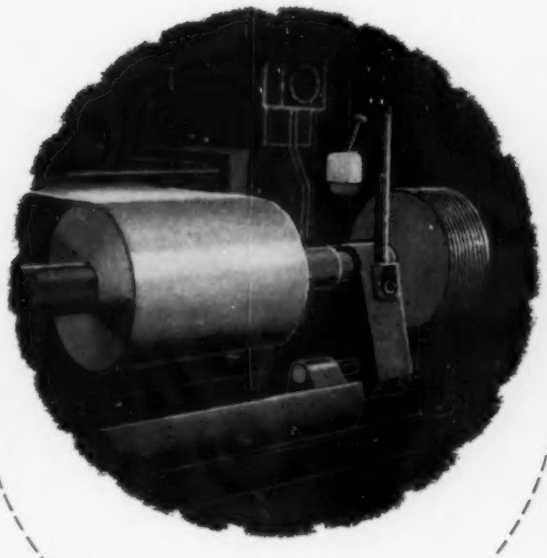

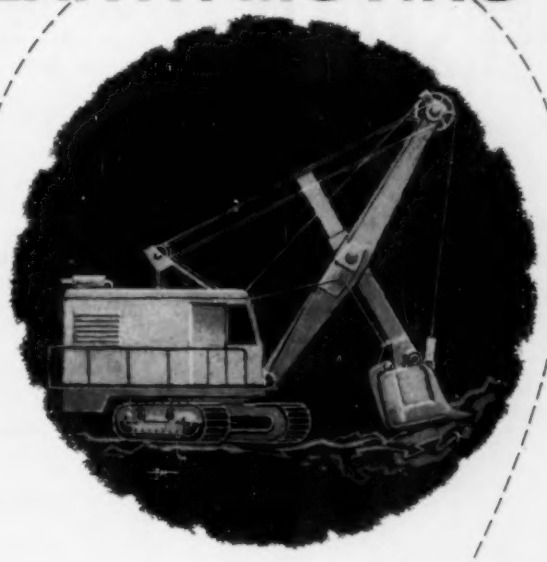

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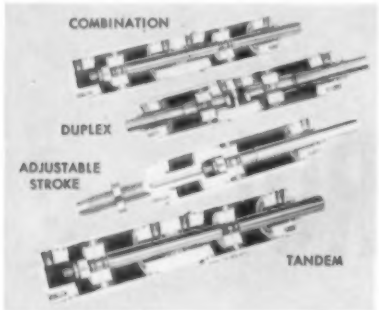

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BRIEFS continued

ting. A pipe plug standard is being developed and coding of fittings is progressing. Acceptance of electric steel welded tubing has progressed to the point where adoption by JIC at its next meeting is likely.

• **Dimension coding**—An effort is being made to have all cylinder manufacturers use the same letter symbols to indicate dimensions for envelop, mounting, rod ending, port size and port location. There is no intention to standardize on actual dimensions. The goal is to get "1", for example, to stand for the same dimension on all cylinders. Progress is slow.

• **Spring meeting**—Bedford Springs, Pennsylvania will be the site of the May meeting. A study of shows and exhibits and a study of various markets will be two subjects on the spring program. ▼▼▼

Continued on page 38

BRIEF NOTES

HOME STUDY COURSE . . . Getting underway is a correspondence course in fluid power. This is an 18 chapter course under personalized instruction by correspondence which is followed by attendance at a "workshop" session. Authored by Harry L. Stewart and Dr. R. C. Binder, the course is offered by the Training and Education Department, Industrial Services Division, Hitchcock Publishing Company.

U. S. RUBBER CO. WILL SPEND $120 MILLION . . . on research and development over the next five years. H. E. Humphreys, Jr., president, stated one objective is to bridge the gap between rubber and metals with rubber types, plastics, and blends of both.

BRAKE FLUID WITH HIGH HEAT RESISTANCE . . . Chrysler Corp., Detroit, announced a hydraulic brake fluid with a boiling point of 390 F.

MINNESOTA RUBBER'S COMPOUND HAS UNDERWRITERS LAB APPROVAL . . . Approval was given to Compound 503A, produced by Minnesota Rubber & Gasket Co., Minneapolis, for synthetic rubber seal rings for use in gaskets to seal gas, kerosene, naptha and LP gas, in both gaseous and liquid states.

BUSINESS BRIEFS

RESISTOFLEX PROFITS AND SALES CONTINUE HIGH . . . Edgar S. Peieris, president, advised that sales for the first quarter, beginning July 1, totalled $2,283,128, while net profits after taxes were $154,903. Despite some cancellations, order backlog remains within 10% of their all-time record.

MISSILE CYLINDERS CONTRACTS FOR WEATHERHEAD . . . Two contracts covering launching-rail deceleration cylinders and launcher-down hydraulic cylinders for Nike-Hercules Launchers, have been awarded by Consolidated Western Div., U. S. Steel Corp., Los Angeles, to Weatherhead Co., Cleveland.

AMERICAN BOSCH ACQUIRES HYDRAMOTIVE . . . Hydramotive, Inc., Cleveland, was purchased by American Bosch Arma Corp. Hydramotive makes the Hydrotor, a hydraulic starter for diesel and gasoline engines.

AEROQUIP VOTES QUARTERLY DIVIDEND . . . The Board of Directors of Aeroquip Corp., Jackson, Mich., voted a regular quarterly dividend of 10 cents on the 1,101,852 common shares presently outsanding. The current fiscal year is the twelfth consecutive year in which Aeroquip has paid dividends on its common stock.

In One Second—A Flame Thrower on Wheels!

Fire-Safe Hydraulic Fluids:

HOUGHTO-SAFE 600 Series

water-base, maximum efficiency fluid proven by 4 years' use in industry and to date nearly 3 years in Navy carrier catapults. Covers up to 85% of all needs.

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fortified phosphate ester base fluid gives highest hydraulic efficiency with extended fire protection for systems running consistently over 150°F., heavily loaded pumps and bearings.

Have you ever watched hydraulic fluid spray from a broken line? Under pressure, it can carry 50 feet or more. Any time a fork truck or any hydraulic equipment operates within 50 feet of sparks, flame, or hot metal, it becomes a potential flame thrower. But these hazards can be eliminated . . . with HOUGHTO-SAFE.

HOUGHTO-SAFE gives you all the needed features of a top-grade hydraulic oil, including rust and corrosion prevention. It's non-toxic, safe to handle. The Houghton Man can help you take the fire danger out of any hydraulic application. Call on him or write E. F. Houghton and Company, 303 W. Lehigh Ave., Philadelphia 33, Pennsylvania.

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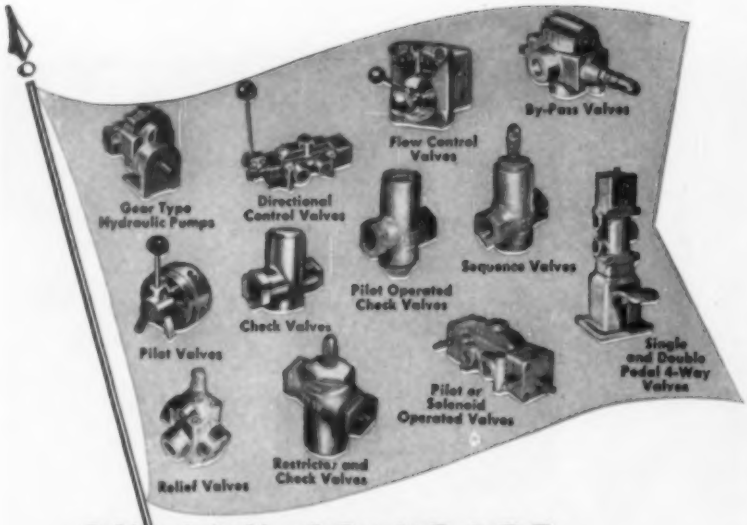

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BRIEFS / continued

SURVEY OF FLUID POWER . . . being planned by BDSA

James Anderson, chief of the Commerce Department's Business and Defense Services Administration has released information concerning a survey of companies making pumps, compressors, valves, controls, actuators, cylinders and accumulators. While details of the survey have not been completed, the purpose is to obtain accurate information about materials consumed by these manufacturers. Total production by units and dollar value may be tabulated along with the sales to industrial, automotive, aircraft and missiles, and marine markets.

Fork truck handles fragile loads without using pallets. Clamping arms lined with 1 inch sponge rubber are closed on the load hydraulically. To insure correct clamping pressure the operator pre-sets a manual pressure relief valve; a pressure gauge mounted on the mast indicates the various settings. Unit is by Lewis-Shepard Products, Inc. Watertown, Mass.

BDSA is industry's representative in government. It is assisted by advisory groups formed by representatives of manufacturers in each recognized industry. The Fluid Power Industry Advisory Group has representatives from 16 companies. These member companies were selected to provide a good cross-section of the fluid power industry. Geographically they are located in all sections of the country; they include small, medium and large concerns; they

Continued on page 40

Don't buy O-rings blindly!

Prove by comparison tests that Parker O-rings seal better, last longer

Comparison tests will show you that Parker O-rings are better. You can't *see* the difference. You can't *feel* the difference. But in *use*, Parker O-rings actually do seal better and last longer!

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These trouble-free, leakproof seals are carefully evaluated for elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals and temperature extremes. Exacting laboratory and service tests make sure that Parker O-rings meet applicable specifications. Whatever your requirements, Parker can supply the O-rings you need.

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Parker O-Lube is especially formulated for O-ring lubrication requirements. It comes in a handy, squeeze-tube container.

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Fixed and Variable Displacement Radial and Gear Type Pumps 1000 psi to 3000 psi—1 to 185 gpm capacity.

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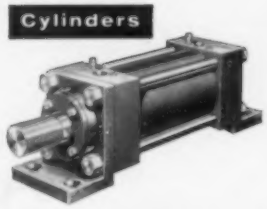
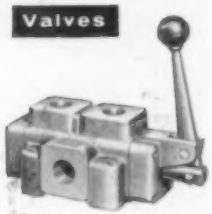


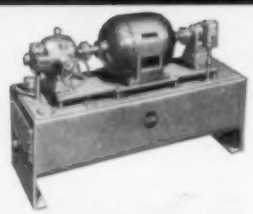
150 to 3000 psi—wide variety of mountings—standard and special types.

Valves



Directional and functional—1000 to 3000 psi—standard threaded, flange and subplate mounting—for every directional and functional valve requirement.

Packaged Power Units



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BRIEFS continued

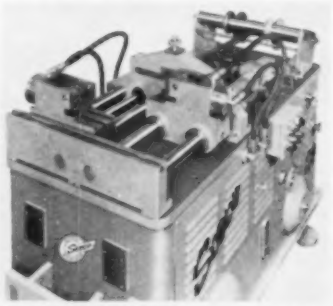
manufacture all the components under consideration by this group. The advisory group working with BSDA will prepare the survey to be sent to all known manufacturers of the related fluid power components early in 1958. The plan is to gather statistics based on 1957 business.

In addition to the matter of the survey to show material requirements and end use, these topics are under discussion: industry and government standards, use of proprietary technical data by government, and manpower problems and essential trades to maintain production. ▼▼▼

Hydraulics Permits Unusual Crosshead Arrangement

This portable feed unit incorporates an unusual crosshead arrangement. Two grippers, each operated by a hydraulic feed cylinder, are sequenced so that while one gripper grips the stock and moves it forward, the other gripper is returned for the next feed stroke.

Condition of the press does not affect the accuracy of the "hand over hand" feed. The adjustable



feed cylinders have a two-piece piston mounted in tandem inside each cylinder. These are designed in such a way that the distance between the two pistons can be changed by turning a stroke adjuster handle on the side of the unit. Positive internal stops assure exact duplication of the stroke length. Shock absorbers are

Continued on page 44

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SURGEPRUF

reusable couplings *and* hydraulic hose

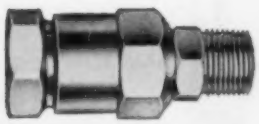
• for fastest in-the-field replacement!

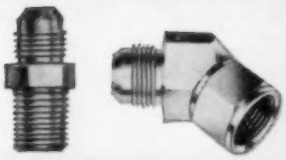
• first choice for original equipment!

Single and Double Wire Hose For Medium-High Pressure and High-Pressure Service

Seamless inner tube of synthetic rubber, reinforced steel wire braid, and synthetic rubber outer cover. Resists abrasion, weather, and oil. Hose temperature operating range: —40°F. to +275°F.

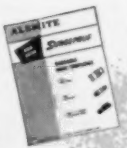
Couplings. Made of high-strength steel. "Double-wedge grip" forces coupling threads through rubber cover . . . grips either single or double wire braid firmly. Saves both time and labor!





Adapters. Full range of sizes in J.I.C. and other threads. One-piece adapters—and swivel union adapters to simplify assembly and avoid twisting strain in cramped quarters.

Hose Assemblies. Types and sizes for all hydraulic lines. No special assembly tools required. Fast, easy assembly with just ordinary tools!



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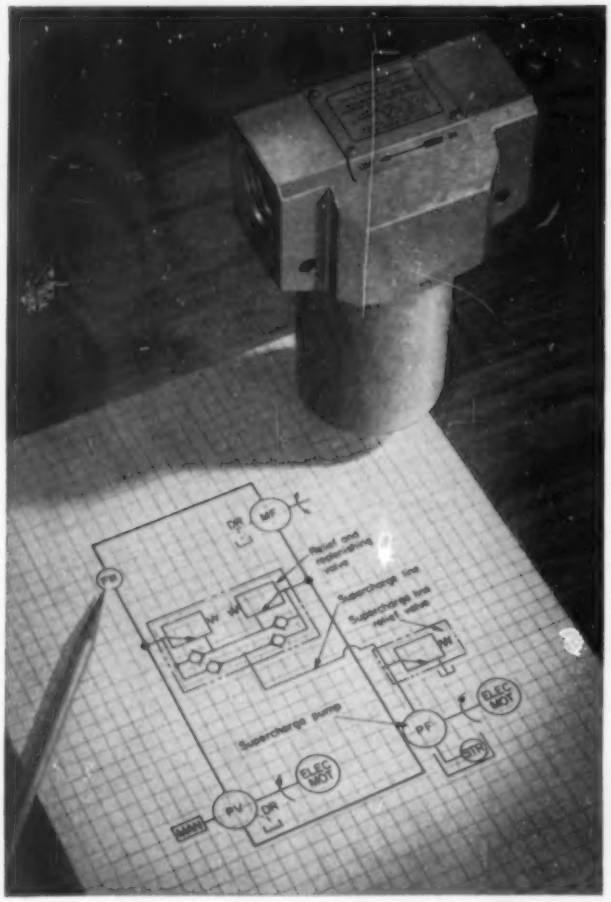
Filters put performance into this adjustable-speed hydraulic transmission circuit



For applications requiring any combination of torque and horsepower characteristics, an adjustable-speed hydraulic transmission consisting of a variable-delivery pump and variable-displacement fluid motor is generally used. In a reversing adjustable-speed hydraulic transmission circuit, either pump line may be the intake side. This type of transmission can be used to advantage in applications requiring a wide speed range. Over-all efficiency for this type of hydraulic transmission is approximately 85 per cent for all output speeds greater than 30 per cent of maximum.

In development of variable-speed transmission circuits, the rules and factors governing the design of hydraulic circuits in general apply. Protection of hydraulic fluid from contamination is essential for dependable performance of the circuit. And Purolator filters provide the most effective protection available today. The unit shown (PR-412-8) is used in many circuits like that above. It is part of a series offering a range in nominal rated capacity from ½ to 12 gallons per minute. The case can be unscrewed and removed for replacement of the element without disturbance to connections. To improve your hydraulic system, get precisely the filter you need by contacting Purolator.

THIS CIRCUIT incorporates a supercharge pump and a reversible replenishing system. Supercharging increases capacity of the main pump by maintaining pressure at the pump inlet and removing the possibility of cavitation at high flow rates. The supercharge pump has its own relief valve which limits inlet pressure to the main pump to approximately 150 psi. The relief and replenishing valve is a single unit which because of the arrangement of the check valves admits fluid to the system on the low-pressure side of the main pump but does not permit fluid pressure to be lost from the high-pressure side despite flow reversal.

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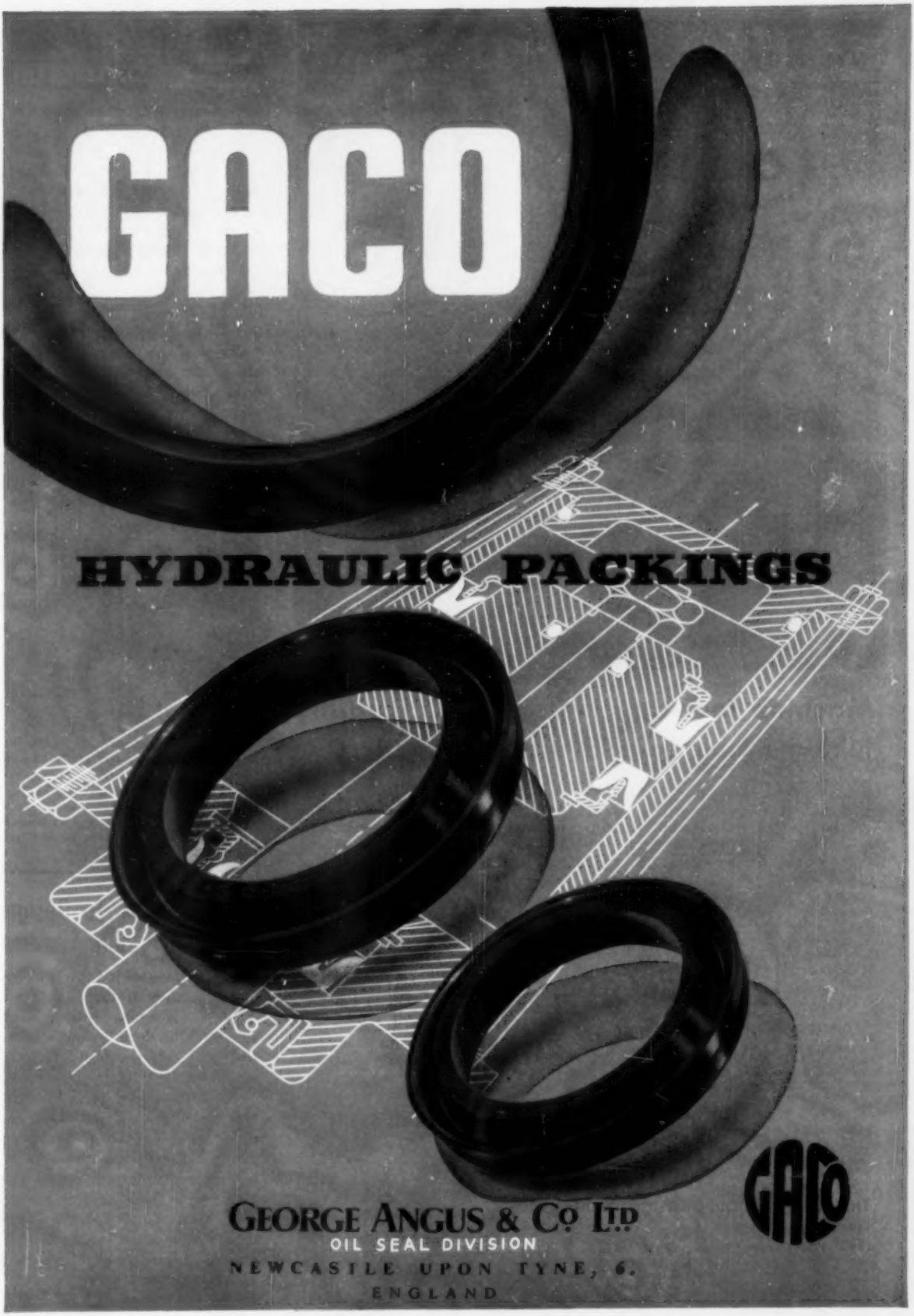
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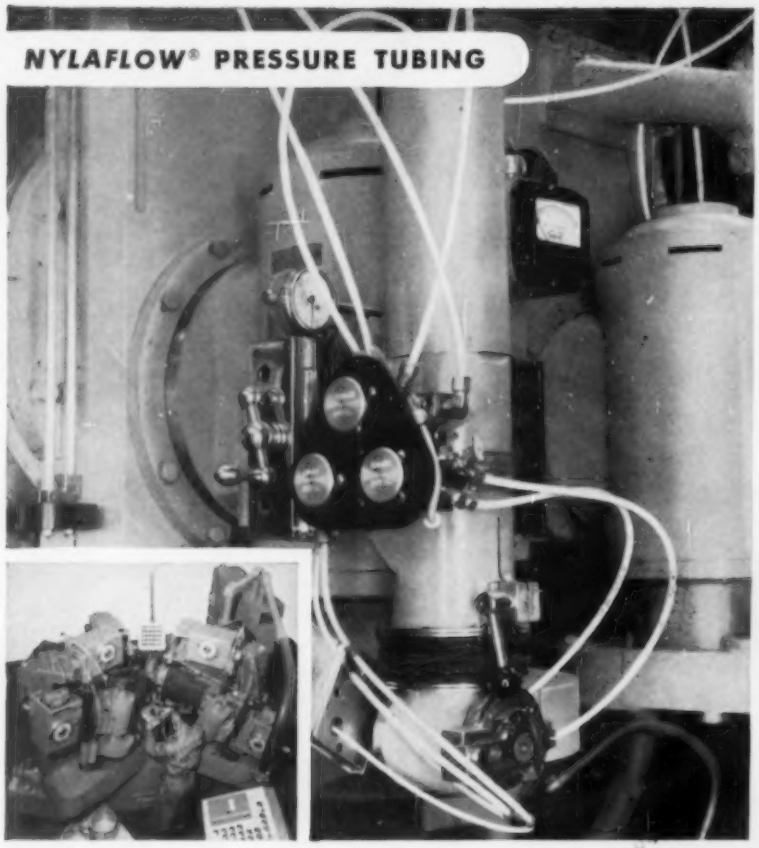


Machine tool designers solve hydraulic tubing problems with flexible *NYLAFLOW*

• Parts and components selected by machine tool builders must meet the strictest specifications and performance requirements. POLYPENCO® Nylaflow Pressure Tubing was chosen for the hydraulic wheel dressers and compensator units of the grinder shown above for these important reasons:

high strength (pressurized at 500 psi) with relatively small size and light weight

retains form—does not sag and foul machine controls

ease of handling

savings in installation

use of standard fittings

• *NYLAFLOW* Pressure Tubing is a tough, flexible polyamide tubing with this unique combination of performance characteristics:

- **High pressure rating at low cost**
- **High resistance to flex and vibrational fatigue**
- **Mechanically strong—resists abrasion and impact**
- **Corrosion and chemical resistance**
- **Serves wide temperature range: as low as —100°F., up to +225°F.**
- **Will not embrittle in storage**

• Available in two short time burst pressure ratings—1000 psi (Type T) and 2500 psi (Type H) O.D. sizes 1/8", 3/16", 1/4", 5/16", 3/8".

Information on characteristics, properties, applications, tubing accessories and installation tools is outlined in new NYLAFLOW Bulletin. Write for your copy today.

THE POLYMER CORPORATION OF PENNA.
Reading, Pa.
Export: Polypenco, Inc., Reading, Penna., U.S.A.

POLYPENCO®

POLYPENCO Nylon, POLYPENCO Teflon†, NYLAFLOW, NYLATRON® GS

† DU PONT TRADEMARK

BRIEFS continued

incorporated to prevent impact at each end of the cylinder.

Reciprocating travel of each pinch gripper is governed by the stroke adjustment within the cylinder. The pinch grip takes place before any forward feeding is possible, and the grip is not released until the forward motion has been completed. Thus momentum of the stock creates no overtravel at the end of the feed-in stroke, and the grippers are open before the return stroke begins. Sesco, Inc., Detroit, Michigan, manufactures the unit. ▼▼▼

Fork truck lifts and carries 30,000 lbs of logs. Logs are handled by 30 degree tilting forks underneath and two hydraulically operated arms on the top to clamp logs and hold them in place during transit. The truck was developed by the Industrial Truck Division of Clark Equipment Co.

How To Design Hydraulic Systems

. . . was the subject of the October meeting of the New York A.S.M.E. Hydraulic Section. Guest speaker Ellis Born, hydraulic control engineer, Denison Engineering Division, American Brake Shoe Co., discussed three systems.

System 1—highlighted the use of a variable volume vane type pump in the hydraulic system of a lift truck. This unit operates as four pumps in one. Manifolding can be varied to provide controlled and uncontrolled flow in various combinations by the use of internal check valves.

Continued on page 46

a rare combination

QUALITY

The recognised Keelavite standards of high quality maintained throughout.

INGENUITY,

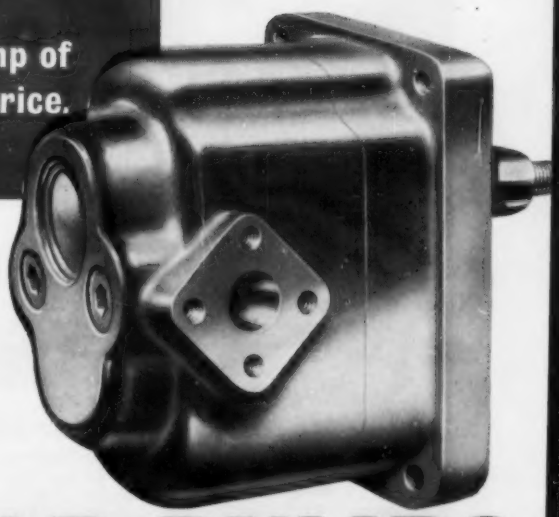
Patented features include precision hydraulic location, eliminating wear plates

SIMPLICITY

Four components only achieve the ultimate in simplified construction.

ECONOMY

The end result is a quality pump of high efficiency at a very low price.



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Keelavite GEAR PUMPS

G.P. SERIES

THE RANGE COVERS SIZES FROM 4 TO 28 G.P.M./1000 R.P.M.
MAXIMUM PRESSURE 2000 P.S.I. — PEAK SPEED 3000 R.P.M.

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Let us take over your inventory problem!

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ANY BORE SIZE • ANY MOUNT • ANY STROKE

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Sounds too good to be true, but here's real help for engineers and designers who need fast action on cylinders. Carter's exclusive key type locking design and simplicity of parts *makes it possible to ship cylinder orders in 24 hours or less!* Now you can have rugged, dependable, compact quality cylinders when you want them. We produce around the clock. Your order is in process *minutes after we get it.*

Service on spare parts is good too! Experienced engineers and parts stocks are located in 40 different locations in the U. S., Canada and Mexico.

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Orders taken day or night. If you need fast service call your Carter representative or the plant. LANSING, ILLINOIS, GRanite 4-3305 or CHICAGO, BAyport 1-7186. Teletype LNSG, ILL 1119X.

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Complete bound file with ordering details for: Air Cylinders; 750 Lb. Hydraulic; 1500 Lb. Hydraulic; Clamp Cylinders; Air Valves; Built-in Valve Type Cylinders. Complete with parts data, specifications and prices. Send today!

CARTER CONTROLS INCORPORATED
2972 Bernice Road • Lansing, Illinois (Chicago Suburb)
AIR CYLINDERS • HYDRAULIC CYLINDERS • AIR VALVES
ROTARY ACTUATORS • SPECIAL CONTROLS

BRIEFS / continued

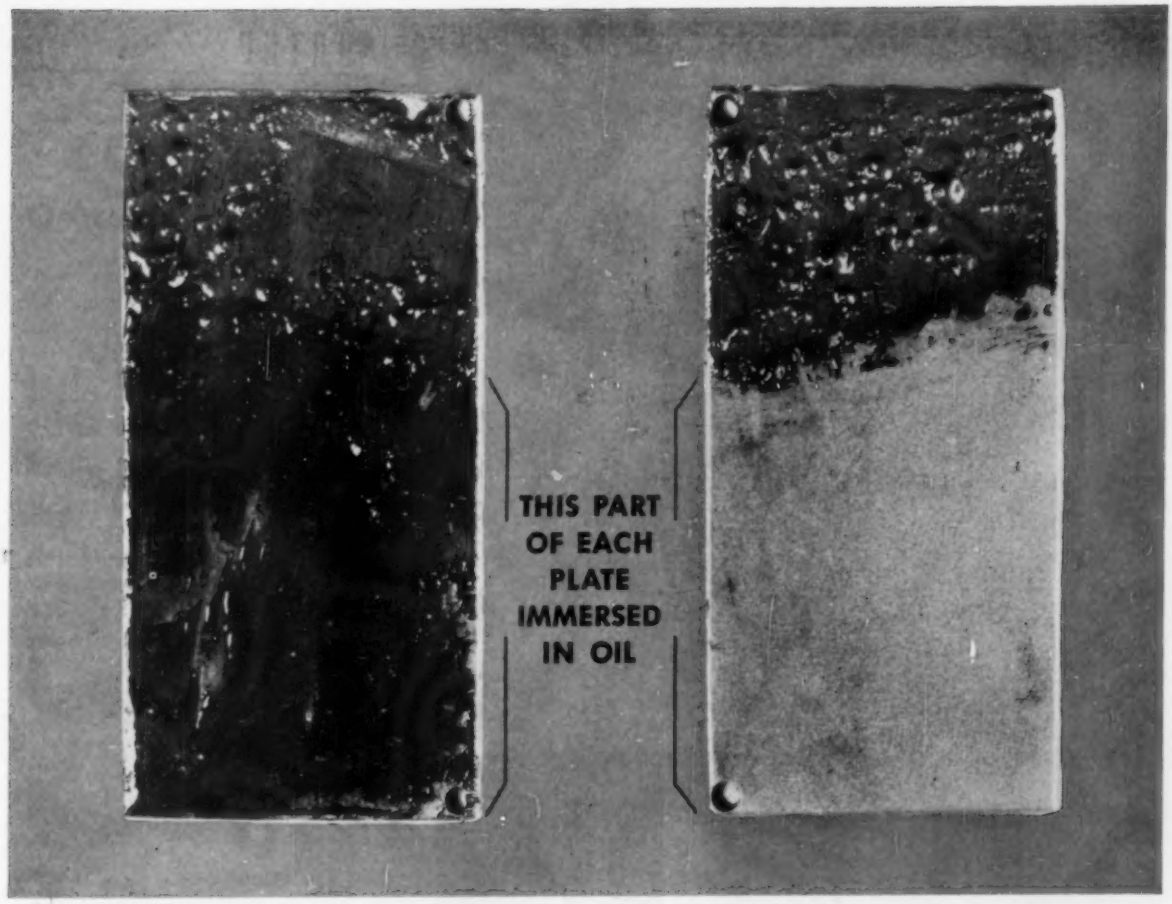
System 2—a closed hydraulic system on a machine tool for milling spars. With a variable volume piston pump and a fluid motor, speed or direction of the fluid motor is dialed as required by using the discharge of the pump as the prime mover. Other sequences of operation are also supplied by the same pump. An intresting comment by Mr. Born concerned "rubber band effect", (lag in response due to compressibility of fluid and the breathing

Lift truck developed by Yale & Town Mfg. Co., Philadelphia, uses secondary lift channels with separate hydraulic cylinders and controls. Three ton loads can be raised from 72 inches below the floor to 41 inches above ground level.

of tubing or hose which is characteristic when used in extremely long runs), a factor in this system when the fluid motor was located a good distance from the pump and required long lines.

System 3—a 45 gpm, 1200 psi system, used on earth moving equipment. Efficiency of the system is relative to pressure drop in overall transmission of fluid from the pump through the valves and on to the cylinders. Critical areas of pressure drop in various stages through the system could be eliminated by a more meticulous design approach in specifying line sizes, porting sizes, etc. Additional commentary was given to the subject of pressure drop within systems by evaluating the benefits of going to higher pressures. ▼▼▼

Continued on page 48



This sludge-coated metal plate was partially immersed in a beaker containing a *regular hydraulic oil* heated to normal operating temperature. Though the oil was agitated throughout the test, nearly all the sludge remained on the plate.

This similarly sludge-coated plate was partly immersed in a SUNVIS 700 oil, also heated to normal operating temperature. During the same period, with the same degree of oil agitation, the immersed part of the plate was rinsed clean of sludge.

Simple test shows how

SUNVIS 700 OILS CLEAN HYDRAULIC SYSTEMS...WITHOUT SHUTDOWNS

Sunvis® 700 oils clean while they work. Their cleansing action removes deposits in systems contaminated by dust, sludge, varnish, and other foreign materials.

SUNVIS 700 oils carry these contaminants in suspension for easy removal. This eliminates costly teardowns. Systems stay clean. In addition to being ideal for hydraulic systems, SUNVIS 700 oils are also suited for circulating systems and gear boxes.

If you want exceptional cleaning ability, oxidation stability, rust prevention, film strength, you need SUNVIS 700 oils. Ask your Sun representative for full details, or write to SUN OIL COMPANY, Philadelphia 3, Pa., Dept. AH-12.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY Philadelphia 3, Pa.

IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

SUNOCO

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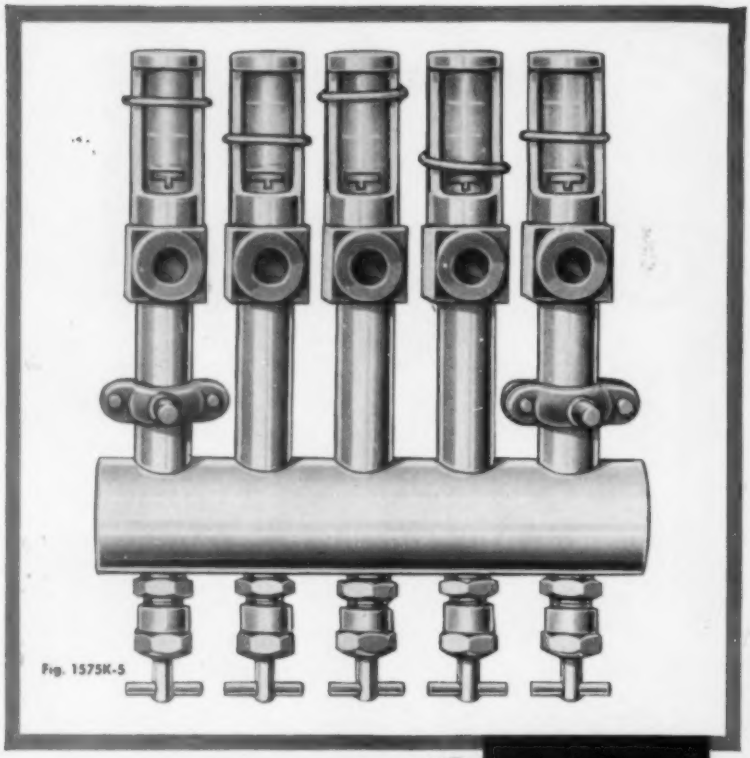


Fig. 1575K-5

NEW

..from NUGENT

PRESSURE SIGHT FLOW LUBRICATORS

Fig. 1575

Now you can deliver lubricating oil or other liquids under pressure, in accurately measured quantities, to high or otherwise inaccessible points with the Nugent pressure sight flow lubricator. They are available as single units or in multiples to 15 depending upon the number of feeds required.

Each lubricator making up a multiple unit is capable of feeding fluid in amounts varying from several drops to two pints per minute by simple adjustment of the individual needle valves.

Single lubricators are available with 1/4" or 3/8" ips inlet and outlet. Inlet sizes of multiple units range to 3/4" ips with 1/4" or 3/8" ips outlets. All are designed for 125 psi maximum working pressure.

Write for complete details.

ESTABLISHED 1897

WM. W. NUGENT & CO., INC.

3432 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

BRIEFS continued

Ideal Seal

An extensive survey pointed up what users want in a sealing device for pipe connections.

The ideal device should seal with pressure; withstand repeated pressure impact; and maintain sealing ability under vibration, repeated suction shocks, and vacuum.

Seal should be maintained under proof pressures up to 10,000 psi and operating pressures to 3000 psi. It should be usable with standard pipe threads, reusable many times and easily installed without special tools or pipe dopes.

Hydraulic pump installation on this front end loader features simplicity of mounting. Napco Construction Equipment Division, Napco Industries, Inc. Minneapolis, designed this unit to mount in direct line with the engine crankshaft. Pump is driven from a gear on the transmission mainshaft.

Operating pressures from 100 to 3000 psi were most-named as ideal. About 13% asked for operating pressures above 3000, with 5000 psi as ideal. Over 93% wanted a device effective with all fire-resistant fluids.

All wanted easy installation. The seal should be usable with standard pipe threads and should permit fitting to face in any direction without high tightening torque which causes distortion. The survey was made by Tru-Seal Division of Flick-Reedy Corp.▼▼▼

NAUGATUCK Paracril

THE OIL-RESISTANT NITRILE RUBBER

superior ozone resistance ● greatly increased flex life ● even higher abrasion resistance

The secret of obtaining these valuable new properties in the vulcanizate lies in a method—recently developed by Naugatuck research—of compounding PARACRIL® with other inexpensive materials. The additives modify and fortify the PARACRIL, greatly expanding its range of application. For example, in the manufacture of hose intended to carry or be used around oil or petroleum distillates, PARACRIL can now be used to make long-lasting *outer jackets* and oil-resistant tubing.

The compounding secret that makes PARACRIL the *ideal all-around oil-resistant rubber* is available to PARACRIL users from Naugatuck's synthetic rubber and rubber chemicals technical representatives. Write or wire to have one of them call on you.

Naugatuck Chemical

Division of United States Rubber Company, Naugatuck, Connecticut

CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario • Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • CABLE: Rubexport, N.Y.

Correct Lubrication in Action . . .

$13,388 saved in 6 months

Vulcanized Rubber and Plastics Company has been engaged for 75 years as a leader in precision molding and extrusion of hard and soft rubber—injection molded thermoplastic, and reinforced plastic parts for major industries and, in addition, is one of the world's largest manufacturers of combs.

Mobil **SOCONY MOBIL**

Leader in Lubrication for over 92 years

in the **Rubber and Plastics Molding Industry**

on maintenance, material, man-hours!

How the Vulcanized Rubber and Plastics Company made this substantial saving with the help of Socony Mobil!

In just six months the Vulcanized Rubber and Plastics Company has saved twice the total value of all its oils and greases purchased during the whole year of 1956! Beginning January, 1957, the company protected their Morrisville, Pennsylvania, plant with a Socony Mobil program of Correct Lubrication.

Plant engineer and Mobil lubrication specialists concentrated all their efforts towards improving efficiency of the plant's 42 hydraulic systems. Hydraulic fluids were standardized . . . filtering schedules set up . . . regular maintenance periods established. Periodic Mobil laboratory reports helped check oil quality and efficiency of filtration system.

Savings were swift and sizable. Downtime dropped sharply. Hundreds of repair and maintenance man-hours were eliminated . . . material costs cut. In total, $13,388 saved on the plant's hydraulic systems.

This is Correct Lubrication in Action. The cost-cutting program that devotes Mobil specialists, Mobil facilities, and Mobil's 92 years of lubrication experience to assure utmost protection and full service life from every Mobil product.

SUMMARY OF SAVINGS ACHIEVED THROUGH CORRECT LUBRICATION

* **$1,628 saved on hydraulic oils**—Following Mobil recommendations, plant replaced eight different hydraulic oils with only two Mobil products. This improved dispensing control . . . simplified reclamation . . . cut application time.
* **$2,400 saved on hydraulic system maintenance**—Before Mobil program, maintenance on hydraulic pumps, screens and valves in the injection molding department required two men on full-time basis. Program has proved so effective that equipment today requires only periodic inspection.
* **$100 per month saved on repair parts**—Prior to Mobil program, shafts on Vane-type pumps were snapping due to contaminants wedging into close-tolerance clearances. Cleaner oil and regular application under Mobil program eliminated problem . . . cut repair parts cost $600 in 6 months.
* **$8,760 recovered on press room operation**—Compared to same period in 1956, savings made in Vulcanized Rubber and Plastics Company's Press Room amounted to: $3,960 saved through elimination of downtime. $4,800 cut by reducing maintenance man-hours. Total—$8,760 saved in six months.

Correct Lubrication

A proved program to reduce manufacturing costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

Useful Literature

For your free copy of publications reviewed, fill in the reader service card

AIR CYLINDERS . . . from 1½ to 14-in. bore are described in Bulletin No. 103, released by Mo-Bar Hydraulics, Inc., Waukesha, Wis. Complete specifications are given, along with engineering data, dimensional sketches and illustrations. Units feature compact size and quality materials.

CIRCLE 140 ON READER SERVICE CARD

HYDRAULIC ACCUMULATORS . . . of the piston type are the subject of a 34 page manual issued by Industrial Hydraulics Division, Parker-Hannifin Corp., Cleveland, Ohio. Functions and suggested applications of piston accumulators are discussed, and performance charts and engineering data are supplied for 14 models ranging from 10 cu. in. to 10 gal. oil capacity.

CIRCLE 141 ON READER SERVICE CARD

HEAVY-DUTY ROTARY PUMPS . . . is a new bulletin released by Worthington Corp., Harrison N. J. Engineering drawings and specifications of rotary pumps for capacities to 25 gpm and pressures to 500 psi are given.

CIRCLE 142 ON READER SERVICE CARD

TESTING FACILITIES . . . formerly available only to manufacturers of military equipment have been opened to commercial industry. Electric Boat Div., General Dynamics Corp. has published a brochure entitled "Test Facilities at E. B." which depicts some of the facilities and services now available at the company's Robinson Research Center, Groton, Conn. The hydraulic and high pressure air plants and hydraulic shock machine should be of particular interest to fluid power engineers.

CIRCLE 143 ON READER SERVICE CARD

STEEL TUBING . . . A general catalog describing seamless and electric-resistance welded steel tubing has been issued by Ohio Seamless Tube Div., Copperweld Steel Co., Shelby, Ohio. Seven-page booklet covers carbon and alloy seamless steel tubing in mechanical, aircraft mechanical, airframe quality and pressure grades, and electric-resistance welded carbon steel tubing in mechanical and pressure grades. Fabricating and forging of steel tubing into special shapes and parts to customer specifications is also described.

CIRCLE 144 ON READER SERVICE CARD

VALVE SIZING CHARTS . . . to simplify regulator valve sizing are presented in Bulletin J-SC, published by Jordan Corp., Cincinnati, Ohio. Booklet shows how to size sliding gate regulator valves and provides technical data applying to all makes of valves—tells how to adjust sizing for variations in pressure, temperature, viscosity, specific gravity, etc. Charts cover steam, liquid, and gas services. A cross-reference method of compiling eliminates need to use rulers or slide-rules.

CIRCLE 145 ON READER SERVICE CARD

GAUGE ISOLATOR . . . designed to prevent gauge damage due to pressure surges in all types of hydraulic circuits is described in a bulletin sheet released by Sarasota Precision Products, Inc., Sarasota, Florida.

CIRCLE 146 ON READER SERVICE CARD

BACK-UP RINGS . . . designated Kelon-T (teflon), are produced by W. S. Shamban Co., Culver City, Calif. Bulletin 7015 gives complete engineering information, specifications and dimensional drawings. Fluid power engineers will be interested in the section on characteristics and application of single turn and spiral back-up rings.

CIRCLE 147 ON READER SERVICE CARD

AIR CONTROLS MANUAL . . . offering basic pneumatic control information, should be of interest to users of fluid power. Entitled "Basic Pneumatic Control", this 28 page booklet is available from Westinghouse Air Brake Co., Wilmerding, Pa. Information and illustrations include all types of air control valves, actuators, cylinders, and circuit diagrams of air control circuits.

CIRCLE 148 ON READER SERVICE CARD

V-BELT DRIVES . . . is the title of a 108 pg. book released by Dodge Manufacturing Corp., Mishawaka, Ind. Power transmission by V-Belt is given thorough coverage in 23 sections including photographs, engineering drawings, exploded views and data tables.

CIRCLE 149 ON READER SERVICE CARD

TUBE & BAR STOCK . . . for pneumatic and hydraulic applications is covered in Bulletin No. 156, released by Shenango Furnace Co., Dover, Ohio. Helpful, detailed information on the standard bar and tube stock is given on three special materials: GC Meehanite Metal, GA Meehanite Metal and Type #1 Ni-Resist. In addition to illustrating typical uses and outlining

Continued on page 54

*Snap-Tite

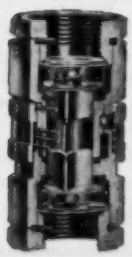
QUICK-CONNECT
QUICK-DISCONNECT COUPLINGS

in larger sizes

immediate delivery
FROM FACTORY STOCKS

SNAP-TITE'S "H" COUPLING, SIZE FOR SIZE, IS THE SMALLEST COUPLING WITH HIGHEST STRENGTH AND HIGHER EFFICIENCY

Snap-Tite's "H" Couplings are now factory-stocked for quick shipment to you, not only in the smaller sizes (below 1" ID) but in all sizes up to and including 3"—in steel, brass, aluminum, and 303 and 316 **Stainless Steel.** And "H" Couplings can be made to your order, up to 10" ID.



Available with valves to give two-way or one-way automatic line shut-off, or without valves for straight-thru flow, "H" Couplings are built to handle high pressures in hydraulic and air systems.

Recessed valve washers . . . fluted valve stems . . . valve stops with minimum flow restrictions . . . large inside diameter—allow maximum flow capacity with lowest pressure drop.

See the Snap-Tite representative in your city or write for Bulletin 240.

*Snap-Tite, INC.

UNION CITY 1, PENNSYLVANIA

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

UCON
BRAND
HYDROLUBES

HELP

PROTECTION The fire-resistance of CARBIDE's fire-resistant hydraulic fluids has been proved by severe, exhaustive laboratory tests. And, in actual service, water-base UCON hydrolubes have prevented serious fires and injuries during more than 10 years of routine use in all types of industrial hydraulic equipment. The common fire hazards connected with hydraulic operations are eliminated when UCON hydrolubes are used. UCON hydrolubes are classified as acceptable, less hazardous fluids by Factory Mutual Laboratories.

ECONOMY UCON hydrolubes 150-CP and 275-CP are the economical answer to fire-resistance in hydraulic fluids. Most commercial hydraulic equipment can be easily converted to UCON hydrolubes with a minimum of time and expense. UCON hydrolubes have no harmful effects on most packings or seals. In fact, in many instances, reduced leakage losses have been reported. UCON hydrolubes also provide maximum protection against liquid and vapor phase corrosion and have outstanding anti-wear characteristics—thus, pump replacement costs are also held to a minimum.

Why not get all the facts on how UCON hydrolubes can mean protection plus economy for you. Write today for the booklet, "UCON Hydrolubes Spell Safety," F-40134.

UNION CARBIDE CHEMICALS COMPANY

Division of UNION CARBIDE Corporation

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"Ucon" is a registered trade-mark of UCC.

CIRCLE 108 ON READER SERVICE CARD

Useful Literature / continued

the particular features of these materials, the bulletin contains a comprehensive physical properties chart as a useful guide in application. These tubes and bars are suitable for production of gears, liners, pump and valve parts, pistons and sleeves.

CIRCLE 150 ON READER SERVICE CARD

REFERENCE CATALOG-MANUAL . . . describes repeat cycle timers, time delay relays, elapsed time indicators, stop clocks, AC, DC and chronometrically governed timing motors and relays. Bulletin contains 60 photographs of timers, 30 dimensional drawings, 50 charts and diagrams, and approximately 600 catalog item part numbers. A. W. Haydon Co., Waterbury, Conn.

CIRCLE 151 ON READER SERVICE CARD

FILTERS & STRAINERS . . . A 9-page publication released by Rosaen Co., Ferndale, Mich., entitled "Tell-tale Inlet Strainers, Return Line Filters, Pressure Filters" should be of help to fluid power engineers. Subject is proper choice and placement of tell-tale strainers and filters in a hydraulic circuit. Examples of good and bad design are shown with diagrams and explanation. A conversion graph which relates pump delivery, pump size and oil flow is included.

CIRCLE 152 ON READER SERVICE CARD

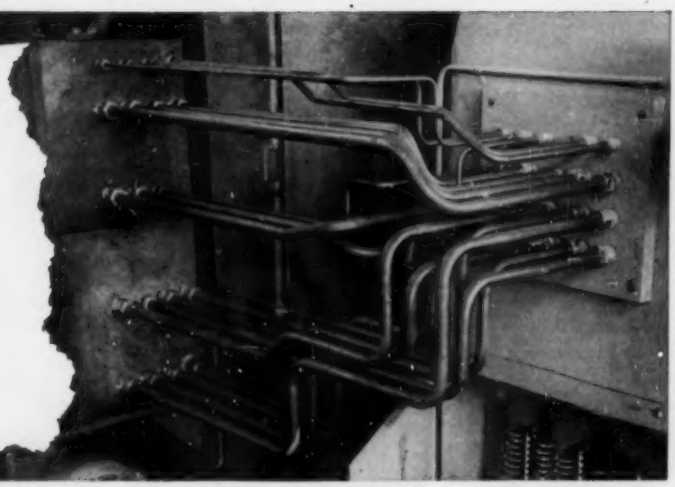
SHEET PACKINGS . . . for every industrial use are described in bulletin P-328 released by Crane Packing Co., Morton Grove, Ill. Detailed specifications, engineering, application and testing data are given on a complete line of industrial sheet packings. The nineteen varieties of packings covered are fabricated from such materials as asbestos, rubber, synthetic rubber, neoprene, silicone, fiber and Du-Pont Teflon.

CIRCLE 153 ON READER SERVICE CARD

ELECTRO-HYDRAULIC SERVO VALVES . . . manufactured by Pegasus Laboratories, Inc., Berkley, Mich. are illustrated and described in Bulletin 120-D. Complete hydraulic, mechanical and electrical

Continued on page 56

two-minute quiz for users of hydraulic line tubing



Q *Is there anything new in hydraulic tubing?*

A Yes, definitely. Republic is producing an electric welded steel hydraulic line tubing to a highly restrictive specification. This steel tube will assure unsurpassed performance in your high-pressure applications. It cannot contaminate hydraulic fluids. It is designated as Republic ELECTRUNITE® Hydraulic Line Tubing.

Q *What "highly restrictive specification"?*

A Designated as Specification HL-1, a copy is available to you by filling out the coupon below. It is designed to meet or exceed *all* requirements of hydraulic line materials produced by other methods. It is the result of knowledge gained in the manufacture of critical ammunition components produced for the Armed Forces. The excellent performance of this welded steel tubing proves its complete dependability beyond a doubt. The type of steel used to produce ELECTRUNITE has some effect on the service life of the resulting tube.

Q *What's different about this specification?*

A It calls for expansion over a plug until the outside diameter has been expanded 25%. When expanded, the required amount of expansion shall be performed throughout a minimum length of 1 inch along the axis of the tubing. This procedure is not only a good weld test, but also an excellent test for detection of any surface steel defects such as seams and laminations.

Q *Anything else?*

A Yes, the reverse flattening test assures complete penetration of the weld, and assures the user and producer that the proper procedure has been used in removing the I.D. weld flash.

Q *Why welded steel?*

A Republic pioneered the electric resistance welded method of producing highest quality steel tubing. In this process, the tube is cold-formed from flat-rolled steel. Both inside and outside surfaces can readily be checked for possible defects. After welding and normalizing, the tube is severely cold-worked after which it receives a final anneal. The resulting uniform tube wall, coupled with its high ductility, provides excellent flaring and bending characteristics. And, the tube is not subject to longitudinal or transverse cracks. It has uniform mechanical properties; it is free of seams and has uniform cross-section.

Q *What about fittings?*

A Republic Steel Hydraulic Line Tubing fits all standard fittings and accessories.

Q *How about sizes?*

A This high-performance tube is readily available in a wide range of sizes, ⅜-inch through 2½-inch, and in wall thicknesses regularly used in hydraulic applications.

Q *Why should I change?*

A Several reasons. Performance is one. This tube will assure unsurpassed performance in all types of applications. Uniform bends and uniform flares make it easy to install and reduce the possibility of vibration or stress failures. Economy is another reason. Republic Steel Hydraulic Line Tubing costs you less. And, it keeps on saving, through reduced maintenance costs.

Q *Where do I buy it?*

A Distributor stocks are now going in. If your distributor is not stocked up yet, write Republic. We'll gladly supply a test sample and full information. And, we'll work with your distributor to get him set to supply your requirements.

Q *How do I get a test sample?*

A Send coupon.

REPUBLIC STEEL
STEEL AND TUBES DIVISION

211 EAST 131st STREET
CLEVELAND 8, OHIO

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-4417R
211 EAST 131 ST. • CLEVELAND 8, OHIO

I'm interested. Please forward me a test sample of Republic Steel Hydraulic Line Tubing.

☐ Please forward a copy of Specification HL-1.

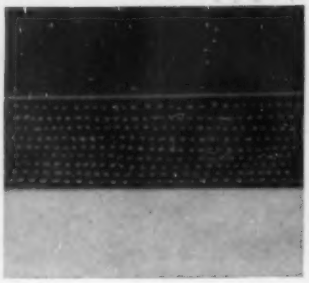
Name _____ Title _____

Firm _____

Address _____

City _____ Zone _____ State _____

Clearly defined contours



Thorough penetration of compound

Clean trimming

CONSTRUCTION SHOWS WHY

R/M FABRIC PISTON CUPS

OUTPERFORM OTHER MAKES

When you examine the cross section of an R/M Fabric Piston Cup, you notice immediately the result of R/M's special impregnation process. Compound penetration of the fabric is thorough and deep. This stops destructive wicking action; increases resistance to ply delamination; and gives you exceptionally long service life.

Note also the general outward appearance of an R/M Fabric Piston Cup — clearly defined contours, smooth surfaces, clean trimming — evidence of superior molding techniques and your assurance of precision fit.

R/M Fabric Piston Cups are manufactured under exacting quality controls. Hardness is consistent; dimensions conform strictly to industry standards.

R/M Fabric Piston Cups are furnished of various synthetic rubbers with cotton duck and/or asbestos reinforcement in sizes to fit cylinders from ½ to 12 in. For specific recommendations, contact R/M's engineering department.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS

R/M's line of molded hydraulic and pneumatic packings includes:

VEE-FLEX PACKINGS
VEE-SQUARE PACKINGS
HOMOGENEOUS VEE-RINGS
FABRIC PISTON CUPS

For complete information, send for booklet

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Passaic, N.J.; Bridgeport, Conn.; Manheim, Pa.; Neenah, Wis.; No. Charleston, S.C.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

Useful Literature continued

specifications are included, along with a drawing and explanation of valve operation. Dynamic specifications are given on two plots of curves showing frequency response and differential current.

CIRCLE 154 ON READER SERVICE CARD

PLUG-IN LIMIT SWITCH . . . manufactured by Micro Switch Div., Minneapolis-Honeywell Regulator Co., is illustrated and described in a bulletin. Design permits complete replacement on the job in only seconds—with no required adjustments and with exact positioning. Adjustability of actuation and versatility of mounting is shown in application drawings and photos.

CIRCLE 155 ON READER SERVICE CARD

LOAD CELL SYSTEMS . . . using tension and compression have been developed by Martin-Decker Corp. Units feature smooth, trouble-free operation under the adverse circumstances of shock-loading and/or continuous vibration. Available bulletin explains method of operation and includes sketches showing possible applications. Bulletin M-27, Martin Decker Corp., Long Beach, Calif.

CIRCLE 156 ON READER SERVICE CARD

PILOT CHECK VALVES . . . Two catalog sheets illustrating single and double pilot check valves with an emergency manual release feature have been published by Fluid Controls, Inc., Mentor, Ohio. The valves provide a manual release feature which permits releasing the check valve under emergency conditions. Catalog sheets provide dimensional drawings and complete engineering details.

CIRCLE 157 ON READER SERVICE CARD

HYDRAULIC TRACING ATTACHMENTS . . . are covered in Catalog No. 57, released by Jones & Lamson Machine Co., Springfield, Vt. Application photo shows how unit mounts on the rear of the cross slide and is template controlled. Catalog also covers two-way hydraulic tracing unit, and a hydraulic collet chuck and bar feed.

CIRCLE 158 ON READER SERVICE CARD

CIRCLE 84 ON READER SERVICE CARD

CIRCLE 100 →

MEASURE

the hydraulic oil you are using against these properties of STANOIL *Industrial Oil*

1 *Stability* — Special solvent-refining techniques and the addition of an exceptionally effective antioxidant give STANOIL Industrial Oil unusual resistance to chemical change.

2 *Good Pour* — Oil has got to flow to the pump. STANOIL's low pour point results from selective refining to remove wax. Special additives further lower pour point. STANOIL flows freely from a cold start. System never fails because oil doesn't flow.

3 *Ability to release air* — All mineral oils absorb air. Oil in a hydraulic system is especially susceptible to absorption of air. Effective release of air depends much on the degree of refining. Superior refining techniques used in manufacture of STANOIL assure ready release of air. A special antifoam agent further depresses any foam tendencies in STANOIL.

4 *Viscosity* — If oil viscosity varies, there's trouble. Oil too thin means excessive slippage or poor oil flow. The pump won't deliver power and there may be excessive wear. Oil too heavy means excessive fluid friction, power loss and sluggish operation. STANOIL has a high viscosity index, is extremely resistant to viscosity change at high or low temperatures, operates just as effectively at start as at full operating temperature.

5 *Rust protection* — Hydraulic system rust can't be tolerated. Rust scratches valve parts, pistons and other system parts. Rust particles can hold valves open or close off small openings. STANOIL Industrial Oil contains an advanced type of corrosion inhibitor. Inhibitor plates out on metal surfaces, effectively protecting all parts of system.

Get all the facts about STANOIL Industrial Oil from the Standard Oil industrial lubrication specialist nearest you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 So. Michigan Avenue, Chicago 80, Illinois.

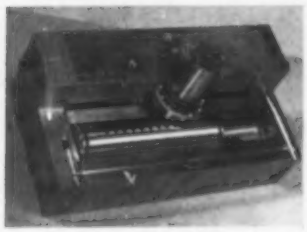
STANDARD

STANDARD OIL COMPANY
(Indiana)

New Products

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

ROTARY ACTUATOR . . . has low internal leakage



Designation: Flo-Tork

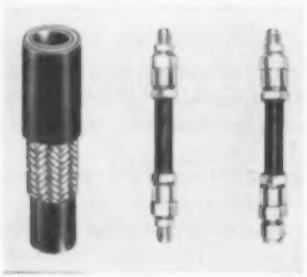
Features: Rectangularly shaped unit for universal mounting contains two reciprocating pistons coupled to the output shaft by racks and a pinion. High-tensile-strength, cast-iron body is precision bored and machined. One-piece pinion and output shaft is supported by two tapered roller bearings or precision ball bearings. Internal lubricant reservoir lubricates all moving parts and makes operation on oil, water, moist or dry air and gases available. Single or double shaft extensions are available. O-ring piston seals keep piston leakage low to provide positive control without drift.

Specifications: Models available with torques from 640 to 22,900 in-lb at 1000 psi operating pressure. Standard rotation is 90 deg; rotation to 360 deg or more can be provided. Length of 640 in.-lb model varies from 5⅛ to 9⅞ in. depending upon degree of rotation. Height is 3 in. Width is 2 3/16 in. Other models are proportionately larger.

Flo-Tork Corp.
Orrville, Ohio

CIRCLE 190 ON READER SERVICE CARD

HOSE AND COUPLINGS . . . are easily installed



Designation: Surgepruf

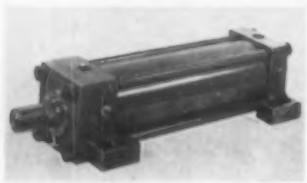
Features: Couplings eliminate the need for skiving rubber covered wire braid hose—bite through the rubber cover to grip the wire braid. Manufacturer claims strength and water-proofing qualities are unchanged. Use of a mandrel in assembling the couplings is unnecessary.

Specifications: Medium-high pressure hose is constructed of synthetic rubber inner tube reinforced by single steel braid. High pressure hose consists of two layers of wire braid separated by layer of synthetic rubber. Operating temperature range is —40 degrees to 275 degrees F. Burst range is 1400 to 18000 psi.

Alemite Division
Stewart-Warner Corp.
Chicago, Ill.

CIRCLE 191 ON READER SERVICE CARD

SQUAREHEAD CYLINDERS . . . have replaceable cartridge



Features: Cylinders are double acting and can be furnished with precision-adjustment cushions at either end or both ends without increasing length. Cartridge assembly is replaceable as a complete unit or the bronze rod bushing and rod packing may be replaced separately. V-type spring preloaded rod packing is available to suit all types of fluids.

Specifications: Units are made for service at 2000 psi or 3000 psi in non-shock installations. The line comes in bores from 1-½″ through 12″ and is available in all mountings. Piston rods are of high strength steel, chrome plated. Cylinder barrel is honed cold drawn steel tubing.

Anker-Holth Division
Wellman Engineering Co.
Port Huron, Michigan

CIRCLE 192 ON READER SERVICE CARD

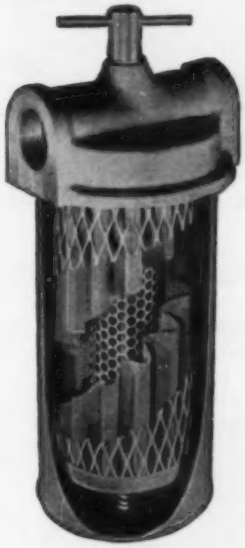
Continued on page 60

MARVEL Synclinal FILTERS

are Standard Equipment!

Illustrated below are a few but a representative group of heavy Construction and Road Building equipment on which the manufacturers install Marvel Synclinal Filters as standard equipment.

SUMP TYPE (cutaway)



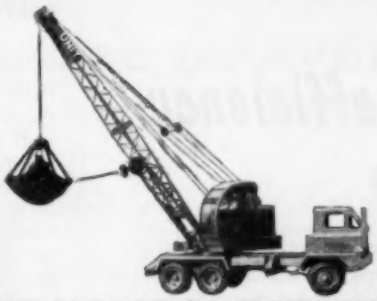
LINE TYPE (cutaway)

"PAYLOADER" TRACTOR-SHOVEL Model HH
The Frank G. Hough Co. Libertyville, Ill.

PIPPIN EVCAVATOR and ANGLING BULLDOZER
Pippin Construction Equip. Inc. White River Junct. Vt.

FRONT END LOADER
Ottawa Steel Products Ottawa, Kans.

25 TON DART TRUCK Model 25 SL
Dart Truck Company Kansas City, Mo.



UNIT CHALLENGER ⅜ YARD EXCAVATOR
Unit Crane & Shovel Corp. Milwaukee, Wis.

22 TON EUCLID TRUCK Model TD
Euclid Road Machinery Co. Cleveland, Ohio

OVER 800 Manufacturers of equipment utilizing Hydraulic or other low pressure circulating systems install Marvel Synclinal Filters as Standard Equipment.

Catalogs containing complete data available on request

A SIZE FOR EVERY NEED

Available for sump or line installation in capacities from 5 to 100 G.P.M. Greater capacities may be attained by multiple installation as described in catalog. Choice of Monel mesh sizes range from coarse 30 to fine 200.

EASY TO CLEAN

Both sump and line types may be easily disassembled, cleaned and reassembled by any workman, on the spot, in a matter of minutes. Line type operates in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY!

MARVEL ENGINEERING COMPANY

7227 N. Hamlin Ave., Chicago 45, Ill. PHONE: Juniper 8-6023

Without obligation, please send me complete data on Marvel Synclinal Filters, as indicated: (AH-12)

- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

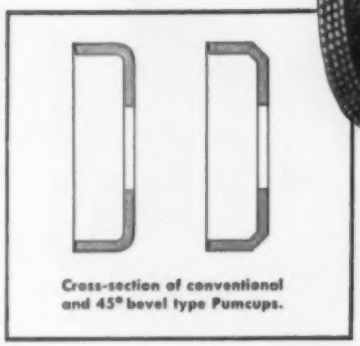
Name _____ Title _____

Company _____

Address _____

City _____ State _____

2-way gain with Pumcups



Cross-section of conventional and 45° bevel type Pumcups.

Darcova Pumcups are available in various types and textures, in a complete range of sizes, to provide unequalled efficiency and long life in reciprocating pumps, air or hydraulic mechanisms.

★ prolonged high efficiency
★ less maintenance

TODAY hundreds of companies using hydraulic controls, air cylinders or reciprocating pumps are *standardizing* on Darcova Pumcups for piston packing, because they eliminate fluid slippage, costly down-time and maintenance.

Darcova Pumcups make the *most* of the cup packing principle. And, they are made in a complete range of sizes, types and texture-engineered compositions for various pressure-temperature-fluid conditions. Pumcups hold peak efficiency for the life of the cups and outlast other packing as much as 3 to 1.

Why not check these claims right in your own plant? Meanwhile get *all* the facts. Just send for Pumcup Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA — THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

New Products / continued

DOUBLE PUMPS
. . . for 2000-psi oil

Specifications: Capacities of each cartridge section range from 3 to 18 gpm, or any combination of

these volumes. Speeds of 1200 and 1800 rpm and pressures up to 2000 psi. Available with either base or flange mounting, and with or without panel-mounted valve combinations.

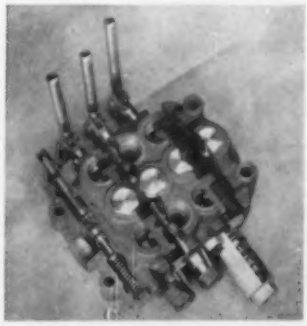
Gerotor May Corp.
Owings Mills, Md.

CIRCLE 193 ON READER SERVICE CARD

HYDRAULIC CONTROL VALVE
. . . saves power

Designation: 3200 Series

Features: Valve provides four positions of control—raise, lower, float and neutral—with or without detent. Float position provides advantages on mobile equipment such as graders. Blade is free to follow contour of the land. Detent feature permits locking plunger in any position. Positive, pilot-operated re-

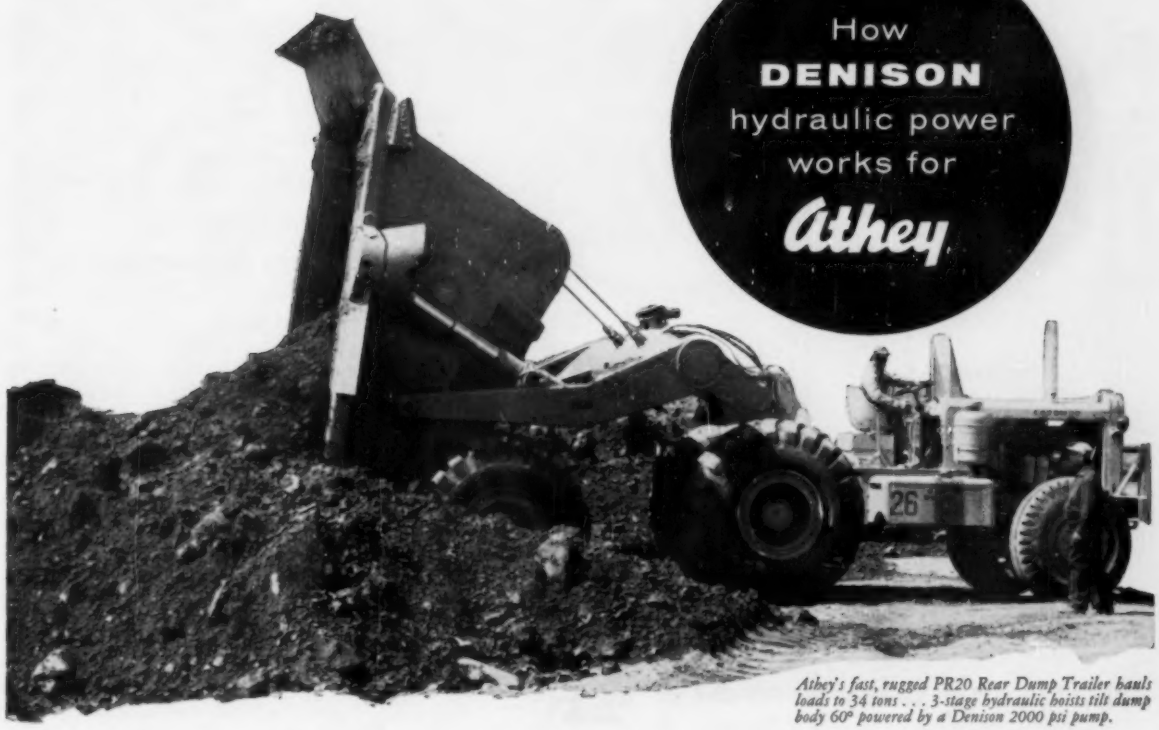


lief valve permits setting valve within 50 pounds variation, and permits use of smaller horsepower engines at a saving in power.

Specifications: Valve has a capacity of 35 gpm and is available with one to six plungers, in completely balanced design with plungers sealed at each end. Unit is accurate-

Continued on page 62

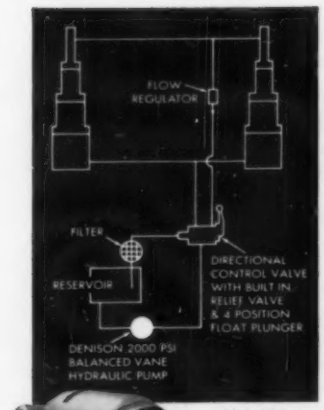
How **DENISON** hydraulic power works for *Athey*



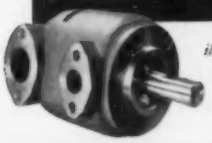
Athey's fast, rugged PR20 Rear Dump Trailer hauls loads to 34 tons . . . 3-stage hydraulic hoists tilt dump body 60° powered by a Denison 2000 psi pump.

34-TON PAYLOAD DUMPED ON THE DOUBLE

. . . another application for DENISON hydraulic power


FLOW REGULATOR
FILTER
RESERVOIR
DIRECTIONAL CONTROL VALVE WITH BUILT IN RELIEF VALVE & 4 POSITION FLOAT PLUNGER
DENISON 2000 PSI BALANCED VANE HYDRAULIC PUMP

Circuit drawing illustrates 2000 psi hydraulic system for powering 3-stage hydraulic hoists on Athey's PR20 Rear Dump Trailers.



Denison 2000 psi vane-type hydraulic pump.

TODAY'S high-speed earthhauling operations call for *fast dumping* to save valuable minutes . . . where minutes are big money. That's why Athey Products Corporation depends on Denison hydraulic power to dump its PR20 Rear Dump Trailers quickly, completely.

Each 34-ton capacity trailer is equipped with one-lever hydraulic controls . . . and 3-stage, double-acting hydraulic hoists that tilt the dump body 60°.

A single Denison 2000 psi balanced-vane hydraulic pump, driven by the tractor engine's power take-off, extends the hoists . . . dependably, efficiently. That's because there's generous reserve stamina in the Denison pump to meet toughest work conditions.

With the Denison "T" Series pump, Athey designers assure all-weather pump-starting ability. Field servicing is speedy because the complete pumping cartridge is removable as a unit. *Result: lower operating cost . . . dependable continuous performance.*

There's less weight, less cost-per-horsepower—with smaller lines and valves with the Denison 2000 psi pump as the heart of a hydraulic system. Design flexibility is unlimited.

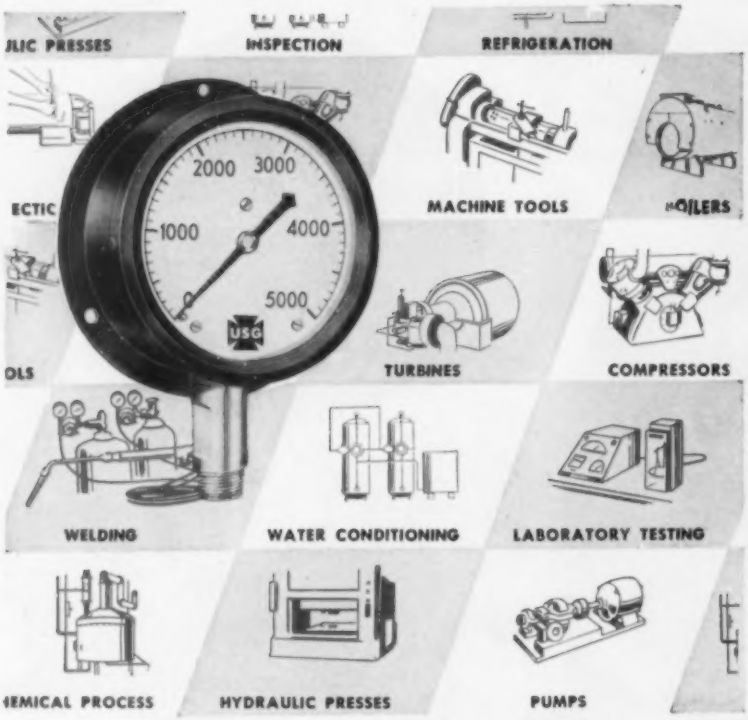
Have your Denison hydraulic specialist tell you more about how the 2000 psi pump can improve performance of your equipment. Write Denison Engineering Division, American Brake Shoe Co., 1166 Dublin Road, Columbus 16, Ohio.

DESIGNERS—ENGINEERS! New Bulletin 201 describes "How To Design More Efficient Hydraulic Power Into Mobile Machinery". Write for it.

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics



industry buys more USG gauges than any other make

HERE'S WHY

- Practically all industrial gauge requirements can be met by USG.
- For high sustained accuracy . . . for long, trouble-free service under severe temperature and atmospheres . . . there's the Supergauge and Solfrunt Series.
- For less exacting applications there are thousands of gauges . . . cast case and drawn steel case units . . . each with components specially qualified for its particular function.
- Every gauge is backed with more than 50 years experience in gauge construction . . . with research that puts every type of gauge through simulated service conditions for months before it is marketed . . . with quality control that enables USG to guarantee performance in service.
- Buy USG gauges . . . pressure and temperature pilots, recorders and controllers . . . transmitters and thermometers . . . and be assured of guaranteed satisfaction in quality, performance and dependability.

Consult the "Yellow Pages" of your phone book for the name of your USG distributor. Call him or write the factory for catalogs.

Supergauge and Solfrunt Reg. T.M.

UNITED STATES GAUGE

Division of American Machine and Metals, Inc.
Sellersville, Pa.

Home of the SUPERGAUGE

MORE THAN 50,000 TYPES OF GAUGES • SUPERGAUGES • SOLID FRONT GAUGES • RECEIVER GAUGES • TEST GAUGES • RECORDERS • CONTROLLERS • TRANSMITTERS • PSYCHROMETERS • AVIATION INSTRUMENTS

New Products / continued

ly rated with high-pressure carry-over, and adaptable to wide ranges of applications.

Hydraulic Unit Specialties Co.
Waukesha, Wis.

CIRCLE 194 ON READER SERVICE CARD

SOLENOID VALVES

. . . are pilot-port operated

Designation: Series J

Features: Designed for general industrial applications, the units operate with a maximum pressure differential of 150 psi in pneumatic

or hydraulic service. They can be mounted in any position, have only two moving parts, and utilize the principle of pilot port operation. Synthetic diaphragms are very durable, and valves have been successfully operated through millions of test cycles with little or no wear.

Jackes-Evans Mfg. Co.
St. Louis, Mo.

CIRCLE 195 ON READER SERVICE CARD

FLEXIBLE CUSHION COUPLING

. . . has rubber-toothed sleeve

Designation: Sure-Flex

Features: Coupling has only three basic parts: two hub flanges and a two-piece rubber sleeve. Internal and external teeth of the sleeve mate with the flange hub teeth and lock tight under torque load without clamps or screws.

Specifications: Available in six sizes for motors from 3 to 80 hp, with shaft bores from ⅝ to 2-¼-in.

T. B. Wood's Sons Co.
Chambersburg, Pa.

CIRCLE 196 ON READER SERVICE CARD

For more NEW PRODUCT reviews turn to page 130

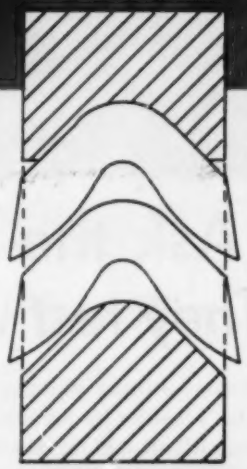
The Biggest Package in Packings!

EXTRUSION-PROOF ADAPTORS

Periflex "Phenol-Fab" bearing type adaptors prevent extrusion and reduce machining costs by providing bearing surface where tolerance on parts is not held closely.

PRELOADED PRESSURE RINGS

Periflex molded duck and neoprene pressure rings with flared lips preload the packing recess without gland pressure and are endlessly molded.



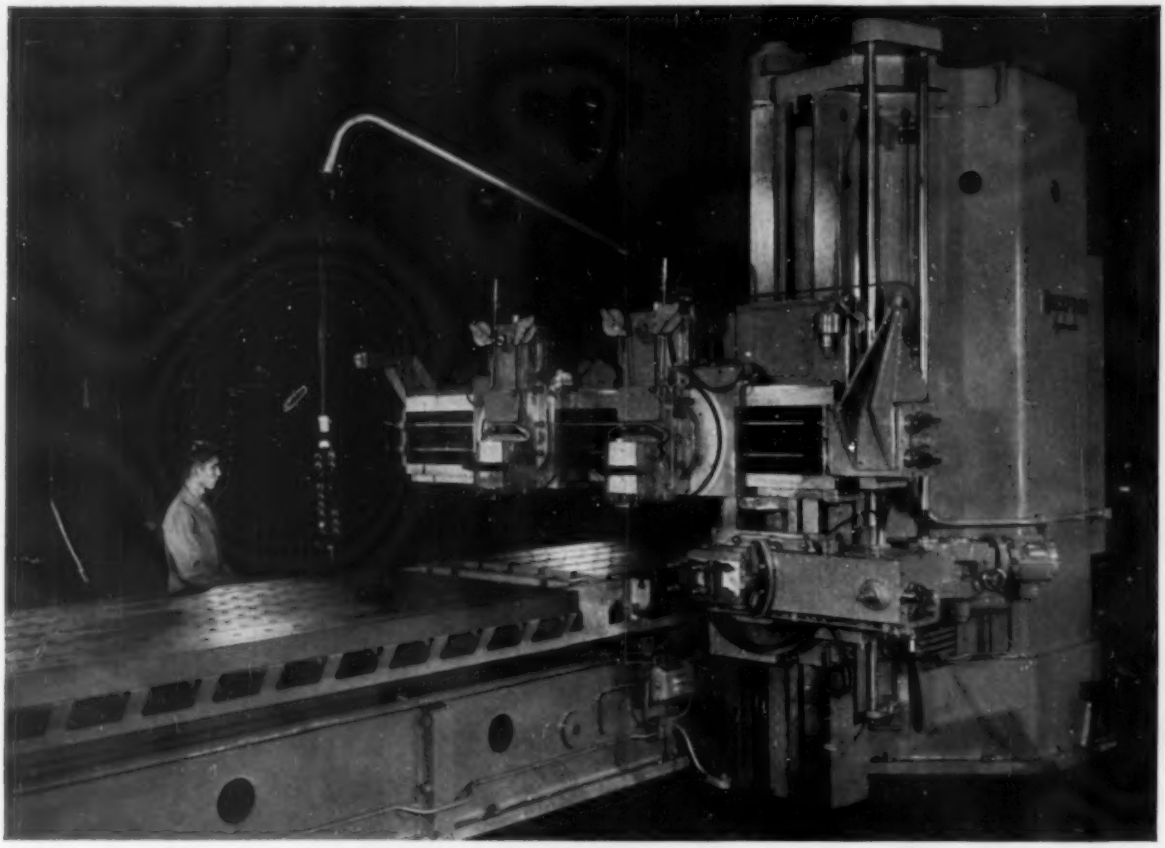
Longer packing life and greater operating efficiency are both assured with this Periflex assembly widely used as rod or piston seal and preferred for proved ability to withstand high pressures and severe operating conditions.

Periflex • Inc.

HAZEL PARK
MICHIGAN

Write for "V"-Ring data sheets.

HY-DRAULIC PLANER is tested with *Texaco Regal Oil R & O* before shipment by the manufacturer, Rockford Machine Tool Co., Rockford, Illinois.



Ask the men who make this machine
They test with Texaco—recommend Texaco

Nobody is better informed than the manufacturer about what's best for his product in terms of performance and long life. Rockford Machine Tool Co. of Rockford, Illinois, uses *Texaco Regal Oil R & O* to test the hydraulic shapers, planers, etc. which it makes. What's more, *Texaco Regal Oil R & O* is prominently recommended on the instruction plate of every hydraulically operated machine that leaves the Rockford plant.

There are good reasons for Rockford's insistence on Texaco. *Texaco Regal Oil R & O* protects hydraulic equipment from rust, sludge and foam. That assures smooth performance and freedom from unscheduled stoppages. Pumps and valves last longer too, because *Texaco Regal Oil R & O* cuts wear to a minimum. As a result, maintenance costs are inevitably low. And *Texaco Regal Oil R & O* has an exceptionally long service life.

No hydraulic equipment need operate without the protection of *Texaco Regal Oil R & O*. It is available in a complete line to meet every operating condition.

Ask a Texaco Lubrication Engineer to help you protect your hydraulic equipment from oxidation. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write: The Texas Company, 135 East 42nd Street, New York 17, N. Y.

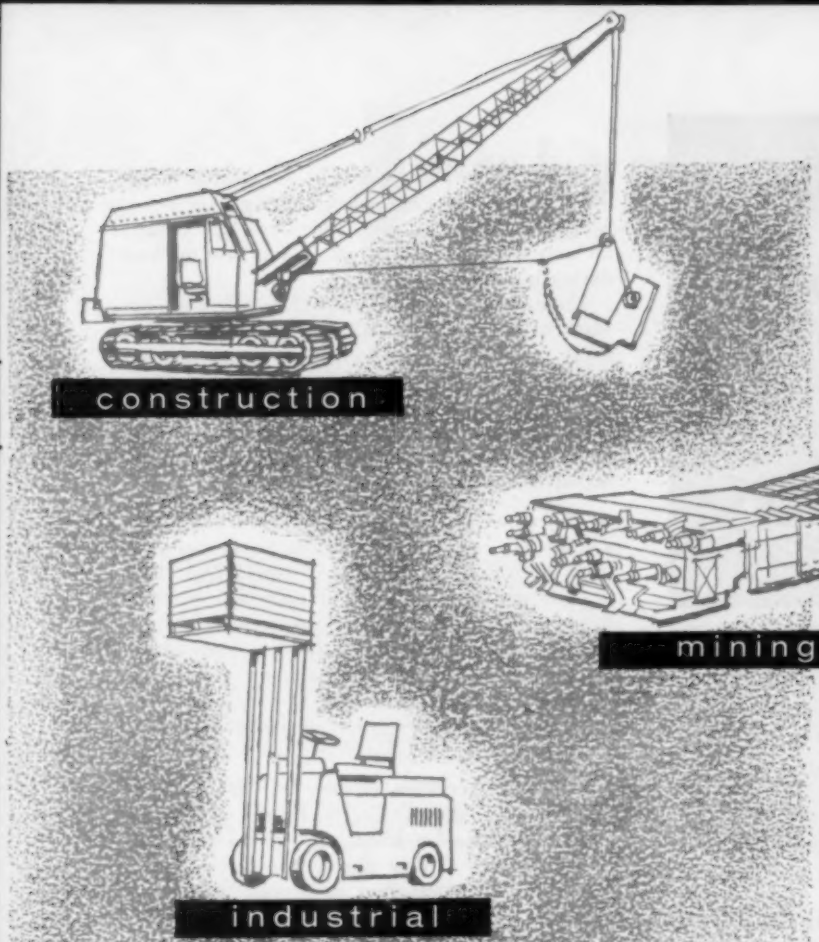
TEXACO

TEXACO Regal Oils R & O

FOR ALL HYDRAULIC UNITS

TUNE IN . . . METROPOLITAN OPERA RADIO BROADCASTS EVERY SATURDAY AFTERNOON

Applied Hydraulics
DECEMBER 1957



COMPONENTS FOR MOBILE EQUIPMENT

. . . 27 designers tell what they need

WHAT do the designers and users of fluid powered mobile equipment want in components for hydraulic and pneumatic systems? What are the trends in pressures, filtering, and pump speeds? How do you design higher power in smaller space? On the following pages are straight-talk comments by leading designers and users of mobile equipment for construction, industrial applications, and mining.

This report presents many ideas for the component manufacturers, and also shows what designers have worked out for themselves in special components and modifications. Although a considerable number of manufacturers are making some of their own components—cylinders, valves, and even pumps—most of them would rather stay out of this business and buy their components commercially. Part of the reason for the mobile equipment manufacturer making his own components is availability—he cannot get what he wants commercially; part of the reason is habit—he started making the components when they were not available commercially and has simply continued.

Many questions raised in the following "interviews" remain unanswered, and many problems are raised without solutions. These do not indicate that the fluid power industry is standing still, indeed the extensive use of hydraulics on electric lift trucks has developed only in the past 10 years. Rather these problems indicate there is plenty of development to come in mobile equipment, and plenty of challenge for component manufacturers.

MORTON M. COKER
Staff Engineer

Caterpillar Tractor Co.

. . . can high pressure hose be flexible?

TRACK-MOUNTED FRONT-END LOADER is filling in soft dirt on pipeline prior to back-filling. Sealed reservoir is big factor in keeping out dirt.

WE HAVE no pipe threads in our machines. Our hose assemblies have flange fittings which seal with an O-ring. These are simple to replace, require no large wrenches, and do not tend to twist the hose during installation.

These fittings will also work in well with our ideas of higher pressures in the future. We are using pressures of 500 to 1500 psi now and occasionally 1750 psi; but future machines will probably operate around 3000 to 3500 psi. Machines are going to be more powerful too, and where we have 100-hp hydraulic equipment now, we will have 300-hp equipment in the future.

• **More swivel joints**—Pumps, valves and piping will be the weak points in these higher pressure systems and will need further development. One of the primary needs is for a high pressure hose which is flexible. Hose which is now available for higher pressures is too rigid, especially since many of our applications already require a short length and rather sharp bend. The answer may be the elimination of hose and substitution of tubing and swivel joints.

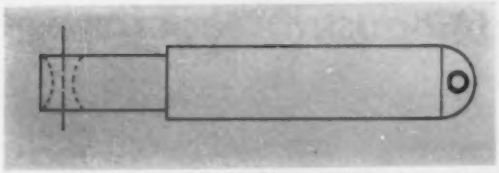
• **Sealed reservoirs**—Filters will also be more important at higher pressures. In our present machines operating at 1500 psi, we are using 20-micron paper full flow filters. One of the biggest sources of contamination in mobile equipment hydraulic systems is poor assembly methods, so we take extra precautions during manufacture. Since the reservoir is sealed, with the pump and valves mounted inside the reservoir on many of our machines, contamination in the field is reduced. At 3000 to 3500 psi we will probably need a 4-micron filter, because it will be as important to remove the small particles as the larger particles. One possibility to get this filtration is to use a fine bypass filter with a course full flow filter.

• **Remote mounted valves**—Our thinking on valve installation is to keep them away from the operator's station whenever possible. Our machines are frequently operated in dangerous locations and under conditions where the operator dislikes feeling fenced in or restrained. Consequently, we try to keep his area as clear as possible, even though this might require a mechanical linkage to the valve.

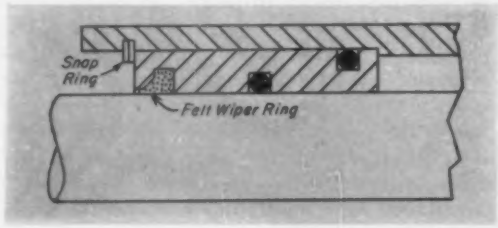
We fabricate our cylinders from tubing with welded-on heads. Mountings are either clevis or socket depending on the cylinder motion required. We are using a spring loaded wiper on an induction-hardened, chrome-plated rod.

We are using seamless tubing for our lines although we have done some testing of welded tubing. We have experienced some difficulty obtaining clean welded tubing, but there is some possibility of adapting this for production, especially as techniques of removing the beads and flash from inside the tubing improve.

. . . why buy gears to drive gears?



CYLINDER ROD MOUNTING HOLE, shown here exaggerated, insures center line loading of the cylinder and reduces buckling tendency.



GLAND FOR SINGLE-ACTING CYLINDERS is fabricated from bronze or aluminum and is easily removable in the field. Felt wiper ring keeps dirt from O-ring and provides rod lubrication.

WILLIAM GLEDHILL
President
Gledhill Road Machinery Co.

BY DESIGNING our own cylinders, we've been able to incorporate many worthwhile features. Many of our cylinders are of the displacement type without a piston. We are using O-rings in these, and although a good surface finish is required, we find there is little trouble if the rod is chrome plated. We use a special ring insert as shown in the figure, and have found that this is excellent from the maintenance standpoint, because removal of the snap ring requires no tools. The felt wiper ring has worked very well in keeping dirt away from the O-rings, where it could cause trouble. Another advantage of felt for this purpose is that it retains some oil and provides lubrication for the rod. The ½-inch extension of the cylinder past the gland provides structural strength to the cylinder to prevent a bell mouth action under pressure.

• **O-ring experience**—We have tried O-rings for piston packing but question their performance because of the difficulty of finishing the inside wall of the cylinder. Even honing is actually a fine threading operation and is not completely effective. Our experience has been that life of the original O-ring is much less than replacement units, and this has led us to believe that the action of the original O-ring is to work in the bore in a sort of lapping operation.

Because our snow plow is sometimes operated at extremely low temperatures, we are considering leather packings in special applications. We feel that natural leather is capable of operating at —60 F and withstanding —80 F.

• **Cylinder mounting**—Another feature we have designed into our cylinders insures perfect centerline thrust and reduces the tendency of long stroke cylinders to buckle. The hole drilled in the rod for mounting is belled out at the ends as shown in the figure. The resulting convex bearing surface insures that the thrust is on the axis of the cylinder.

Hose assemblies on our machines have swaged-on fittings which we feel are a maintenance advantage. Most users would rather re-order by one part number than try to make up a hose assembly with re-usable fittings.

• **Eliminate power take-off**—We would like to eliminate reduction gear power take-offs for our pumps, and that would mean pumps capable of speeds of 3000 to 3800 rpm with a delivery of 12 to 25 gpm. We have used pumps from one pump manufacturer at these speeds and have experienced no trouble. Higher speeds may be practical with a smaller diameter, longer gear. Bearing lubrication is a greater problem at higher speeds, especially on mobile equipment.

. . . develop a package cooling unit for mobile and industrial equipment

WILLIAM HAMILTON

Construction Equipment Div.
Baldwin-Lima-Hamilton Corp.

A SPECIAL starting procedure to warm up the hydraulic fluid enables us to use a reasonable size filter on the pump intake. We back off the adjustable relief valve and drive the pump at low speed until the system heats up. Theoretically we would have needed three filters in parallel for the 126-gpm capacity of the pump. However, pressure curves showed that one filter would do the job, if the oil were hot. The starting procedure limits the size of the driving engine to 75 hp and prevents cavitation.

The hydraulic system is completely closed, so oil level in the reservoir changes very little. There are no large air movements in and out of the reservoirs so our filtration problem is reduced.

• **Oil cooling**—Another temperature control feature which we have incorporated is an air-cooled oil cooler. We determined that this was necessary after calculating the heat input and heat radiation. The duty cycle on our Roadpacker is very severe, and the hydraulic system frequently operates at full pressure of 550 to 600 psi for 10 hours at a time.

HYDRAULICALLY VIBRATED COMPACTORS on this machine weigh 420 lb. each and oscillate at 2200 cycles per minute through ¼-in. One or both end shoes can be folded up, and the entire assembly can be raised hydraulically.

Although this specially designed oil cooling design works well, for other applications we would like to have a packaged cooling unit similar to the pump-valve-tank units which are available.

• **Ball joint cylinder mounts**—Self-aligning ball joints for cylinder rods are needed. Those presently available are expensive, but they do have advantages. Perhaps price could be reduced by higher volume production. We feel that the use of these joints would improve packing and rod life.

• **Leakage control**—Leakage has been a problem for us and we have done some experimenting with various hose fittings. We started out using split flange design, but found they were not readily available at the time in the sizes we needed. We are now using hose assemblies with a pipe thread on one end and flare on the other. We have no plans at present to use straight-thread fittings, because we feel they present a field procurement problem right now. Undoubtedly there will be more use of these fittings in the future.

• **Severe hose duty**—Hose life has been a problem because of the severe usage on our machine. One end of our hose assemblies is fixed and the other vibrates at 2200 cycles per min. We realize this is unusual service, but would like more than the half-season life we are now getting. Of course, increasing the flexible rubber length helps, and we are using pressed-on fittings partly because of their shorter length.

• **Wider range PVT units**—In addition to our main pump, we use a belt-driven pump-valve-tank unit for power steering. Application of these units is now limited by their small size. Also we would like to see higher quality units than what are presently available, preferably in 5 to 10-gpm sizes. For our crane trucks we want a 12 gpm, 700 psi, vane-type package unit with integral reservoir of 3 to 4 qts and relief valve for power steering with two 4 x 8-inch cylinders which drive the two front axles. On smaller units we are now using an 8-gpm unit at 700 to 800 psi.

K. GRUNDVIG
Chief Engineer

Chicago Div. Bucyrus-Erie Co.

. . . flareless fittings for copper tubing

OUR GREATEST need is for a good flareless fitting for use with our air lines of copper tubing. We are now using a 45-degree flare fitting, but feel that we could cut manufacturing costs with a flareless fitting. We have tried a flareless fitting for this purpose and have had some very bad experiences, but we would still like to have an effective fitting for this purpose. Because of the vibration and rough service of our machines this fitting must be rugged. We have given some consideration to the O-ring type for our applications.

Because our machines must operate continually in conjunction with other machines, reliability is a most important factor. We used to have an oil-actuated brake operating at 2000 psi, but leakage would force a shutdown which was extremely expensive. We have redesigned this system using air, so that should leakage develop, the machine can keep operating until the scheduled maintenance period.

GEORGE ANDERSON
Hydraulic Engineer

ROBERT KLING
Chief Engineer

Athey Products Corp.

. . . valves for 150 gpm

THERE is a definite shortage in the mobile equipment field of components for higher capacity. Valves are probably the most critical item. We need them for flows of 100 to 150 gpm. We know of only one manufacturer making valves in this size range, although others are coming into the field. We use individual valves with a single or double spool, and these serve our purpose very well because we seldom have requirements to modify a machine in the field.

• **Higher speed pump**—In pumps we need a unit for 2000 psi and 2000 rpm. A 2000-psi, vane-type pump is now available and we find it can do an acceptable job under reasonable conditions, but we do not think it is the ideal unit. We are also testing a gear-type pump, and find that it has some good features, although we are concerned about decreasing efficiency and increased wear at higher pressures.

The pump housing should not serve as the wear plate. This increases maintenance costs, especially when the pumps are operated at higher speeds. Speeds of 2000 rpm are now common with diesel engines and pumps should be built to operate at this speed without cavitation.

A power savings feature which we have incorporated on our machines is connecting the pump through an air-operated clutch. When you're pumping 150 gpm, even at 75 psi, the power loss is appreciable.

• **Return-line filter**—Because of the large telescopic cylinders which we use, our systems are subject to contamination at this point, as well as during filling. We employ a 10-micron paper filter in the return line with a 15-psi bypass valve. We have also tried to use this filter in filling the system but could not develop sufficient head to pass fluid through it. Recommended replacement period for the filter is 500 hours. We have avoided using a suction filter because of the danger of starving the pump, especially during low-temperature operation. Space is also a problem in installing a suction filter in our 45-gal reservoir.

Available hose is generally adequate, but we feel that manufacturers could improve on bending radii to permit sharper bends. Reusable fittings are good from the maintenance standpoint, but they give less flexible rubber than swaged-on fittings.

STEERING on this machine for which Athey produces the truck body is accomplished by two cylinders on either side of the connecting member. Body is dumped by 3-section telescoping cylinder of which third section is double-acting.

. . . better flow control in directional valves

CLYDE CROSS

Superior Equipment Co.

BECAUSE we designed our side crane for a tractor which we do not build, we had some problems in installing the hydraulic components. We had to use spacers to mount some valves on flat surfaces, and we feel that valve design should not require this.

We would like better flow control in the directional valves. We are using a separate check valve with a drilled orifice to control down travel of the boom, but we feel better control could be incorporated in the directional valve.

CLYDE CROSS is shown with Superior side-mounted crane. Counterweights are raised and lowered hydraulically according to load on crane. System is supplied by a pump-tank-valve mounted on the front of the tractor and accessible through a section of the grill.

. . . standardize pump and valve mountings

L. H. HODGES
Chief Engineer

J. I. Case Co.

WE CERTAINLY recognize the benefits to be gained by higher pressures, but we cannot ignore the fact that original sealing of joints and being able to re-seal a joint once the component has been dismantled is a very great problem at higher pressures. If the trend is toward higher hydraulic pressure, it will create an additional problem for the farm implement industry, because oil cleanliness becomes more acute at higher pressure. The problem of minute particles mixing with the oil is an extremely difficult one for the farm equipment designer.

INDUSTRIAL MOWER is equipped with a hydraulically operated cutter bar. Pump is driven from the front end of the crank shaft of the engine. Hydraulic motor is direct-connected to the fly-wheel on the mower knife.

Here's a list of component developments we would like to see:

- An inexpensive, variable-delivery pump which is easily controlled.
- An efficient and inexpensive reciprocating motor for use with mower drives.
- Standardization of pump, motor, and valve mountings.
- Steel tubing for fabricating cylinders with an ID surface finish smooth enough to eliminate grinding. This would result in a great cost reduction.
- Rotary actuator which is inexpensive and could replace the standard hydraulic rams now used in lifting devices on machines such as plows, harrows, and others. This unit could also be used to actuate turnover plows.
- Some type of *volume* limiting device to control the amount of oil being pumped to a hydraulic actuator to limit its extension.
- Packings which are inexpensive and do not need the high finish gland surface required by present packings such as O-rings.

. . . filter for filling and suction

C. E. GIFFORD, Chief Development Engineer

Huber-Warco Co.

MR. GIFFORD is shown with company's maintainer equipped with front-end loader attachment. Three 2-½-inch bore cylinders are used on the loader. It has a lifting capacity of 1700 lb and ⅜ cu. yd.

FILTER design is an area where we have devoted considerable effort. The hydraulic filter we designed serves both in filling the reservoir and for the pump intake. It is fabricated from galvanized sheet steel in which 24 slots 11/16 x 4 inches are cut. 30-mesh copper screen is wrapped around this body and soldered. This was the design of Mr. R. Keller our chief engineer.

• **Eliminated overtightening of packing**—When we first started using hydraulics in 1933 on our motor graders, rollers, and maintainers, we used cup packing in our cylinders. More recently we have gone to V-rings and have also found the T-ring to be very effective. We are using both reinforced V-rings and homogeneous rubber units, although we do not notice any difference in their effectiveness. We've had some problems with overtightening when packings were installed in the field, but we are now using a gland which has washers, so that the gland nut can be drawn up tight without overloading the packing.

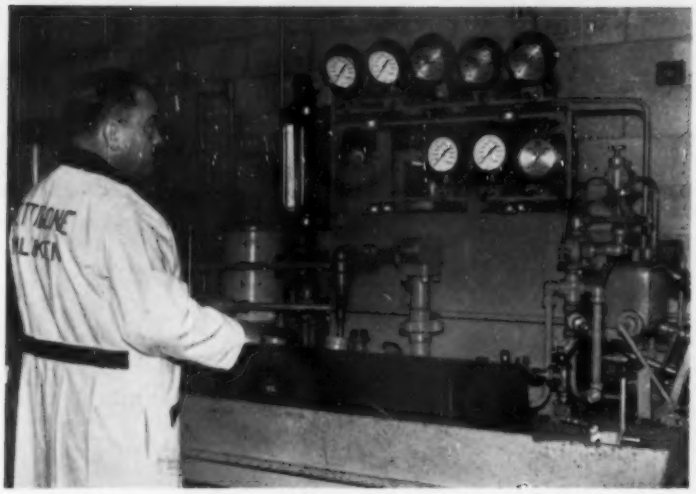
Packings in valves have also concerned us. We have found that one manufacturer's valves which incorporate porting to return leakage to tank are very effective, and we are sold on this feature.

We have given some thought to applying hydraulics to maintenance type reciprocating grass mowers which would operate at about 800 cycles/min. through a 3-inch stroke. Cylinders are one possibility as the actuators although valving might be a problem. Possibly a rotary actuator working through a crank is a better answer.

• **Fluid motors for small machines**—We have done design work with fluid motors and think that they are especially applicable to smaller equipment where inefficiency is not so important a factor. We feel they could be applied very effectively on a small roller of about 5 tons.

Our pump installations have gone through some development. At one time we were using a belt drive, but found that pump life was not good because bearings were not designed for this application. We now mount our gear type pumps on the timing gear of the engine rotating at 1200 rpm. Pressures in our systems range to 1000 psi.

... have quality and performance been sacrificed for quantity and price?



KELLY BROWN
Hydraulic Engineer
Pettibone Mulliken Corp.

BETTER filters should be developed to protect the pump which is the heart of a hydraulic system. We need filters which are not only simpler in construction, but also simpler to install and maintain. We would like to be able to install filters outside the oil tank where they would be easy to remove and maintain. Perhaps they could be sub-plate mounted on the outside of the machine with a minimum number of attaching bolts. Other components should be developed so that installation of shaft seals is an easier and faster job for the men in the field.

• **Standard valve marking**—Most valves are marked so poorly that even a skilled man finds it difficult to understand their nomenclature. Simple and standard marking should be the goal of all valve manufacturers. Valve spools and bodies should be made of materials having the same rate of expansion with temperature. Valves sections should be easily replaced by unskilled field service men, without danger of the valve sections being installed too tight or improperly seated. True, constant flow ratings for valves should be given by manufacturers rather than ratings based on short-time, laboratory tests, which are sometimes given more for price purposes than for technical accuracy.

• **More power in cylinders**—Cylinders should be made of newer alloys to reduce their weight and increase their power potentials. More abrasive resistant material for cylinder walls is needed. We would like better methods of installing piston rings. There should be more research into new types, shapes, and alloys for piston rings. New rod wiper rings must be developed to keep up with the high speed applications. A very important safety feature which should be incorporated in load bearing cylinders is an integral check valve system.

• **Vulcanized hose fittings?**—Hose fittings should have better design for attaching to the hose. Perhaps permanent bonding or vulcanizing might be the answer. Hose should be more resistant to wear on the outer covering, either by using newer types of plastics or some other method not presently used. Better means of inspecting hoses for minute leaks should be a part of the manufacturing process. Identification and typing should be marked permanently on the outside of hose covers to prevent improper installation.

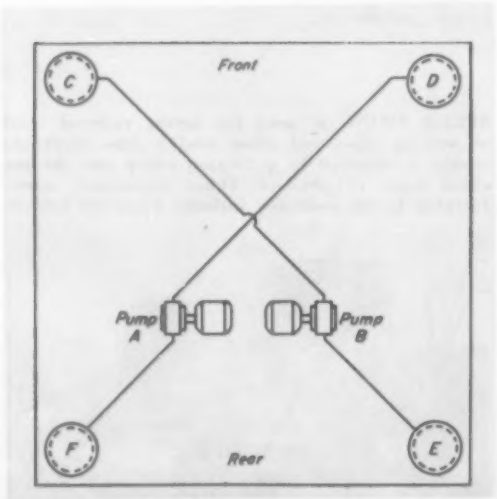
SPEED SWING is used for laying railroad track as well as pipe, and other similar jobs. Hydraulic system is supplied by a 50-gpm pump and the machine uses 7 cylinders. Other equipment manufactured by the company includes front-end loaders.

COMPRESSED AIR SYSTEM in this crane, used in logging, is for actuation of clutches and brakes.

LOY RHOADS, Chief Engineer
Osgood General Div., Marion Power Shovel Co.

J. F. WEIS, Assistant Chief Engineer
Marion Power Shovel Co.

. . . need 3-passage rotary joint for air



LEVELING IS ACCOMPLISHED by pumping fluid from cylinders *C* and *D* to cylinders *F* and *E* or vice versa. If there were no loss of drainage oil through the pump, the average level of the platform would remain the same.

A SPECIAL application which we have on our very large shovels is that of leveling, and we would like to have a reversible pump with 100% volumetric efficiency (no slip). This pump would transfer oil from one leveling cylinder to another without losing overall height of the frame that is being leveled. If there is a loss, the frame will gradually lower. This means that for every pint of oil the pump draws from one cylinder, it should be able to pump exactly the same amount of oil into another cylinder. Futhermore the pump must be able to withstand 1000 to 2000 psi on both ports. Brakes on the pump motors could be set so the oil would not circulate between cylinders with unbalanced loads.

Better high pressure hydraulic hose connections for pressures to 2500 psi should be available. We have experienced hose breakage at the end fittings at these pressures. We now use solid pipe, but we would prefer to use hose, if it were absolutely safe and gave long life.

• **Valve manifolding**—We would like to see

more manifolding of valves on one block and are doing some of this now. Many valve installations make a very poor appearance because of the interlacing of the piping. Installations are much neater if the panels are covered and only the valves exposed. Painted lines on the front of the panel indicate the flow of oil.

• **Rotary joint**—We have been looking for a good commercial source for a rotary joint with at least three passages. We are now buying 2-passage air joints, but they are quite expensive. A commercial source manufacturing these in quantity could lower the price. We prefer not to make our own components. One of the problems is sealing, but we believe O-rings should be the answer.

We dislike paying the price for cylinders which are built to withstand 2000 to 3000 psi, and using them at lower pressures. We'd like lighter units for 350 psi where we operate.

• **Fluid motors for cranes**—We have done development work in applying fluid motors on small cranes. There is a good market for these units, especially in the marine field where a hydraulic hoist can be totally enclosed and well protected from the weather. One design which must be worked out for this application is a way to drop the load and bypass the motor in an emergency. Valving must be very fast, and the motor must not pump against pressure. Hydraulic cranes will also require better throttling than is now available.

. . . protection from hot oil spray

RICHARD BOGART

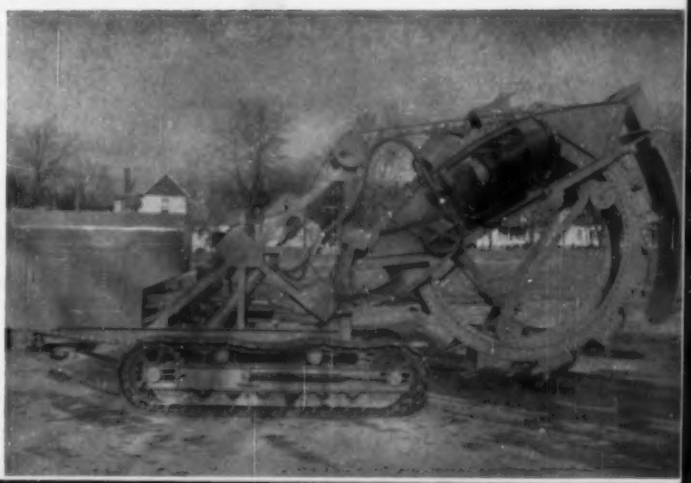
Gar Wood Industries, Inc.

THE BIG advantage of hydraulics on our ditcher is the flexibility in speed control. Speeds of the conveyor, digging wheel, and hoist are independently adjustable. Whereas in the older mechanical system these were fixed.

We are using a 3-element gear pump with two units of 7 gpm each supplying cylinders for the front and rear hoists and one unit of 24 gpm for the conveyor. This type of pump permits considerable versatility in changing over from one capacity to another.

• **Changeover to quad ring**—We've been able to overcome leakage problems and now have few complaints from it. On our hose assemblies we install re-usable fittings which we feel have advantages for maintenance. One leakage problem in our fluid motor was solved by replacing an O-ring with a quad ring which has worked very well.

As a safety measure on our machines, we put a metal cover over the valves at the operator's station to protect him from being sprayed with hot oil in case of line rupture or fittings failure.



DITCHER uses hydraulic cylinders for hoisting front and rear ends of digging wheel, and a fluid motor drive for conveyor. Three-element pump has outputs of 7, 7, and 24 gpm.

. . . bleeder valves for deceleration

FRED BISZANTZ
Vice President

Hercules Galion Products

WE HAVE an unusual operation on our dump bodies for paving. If protective measures were not taken as the telescopic cylinder is extended in from 6 to 10 seconds to raise the body, the inertia of the cylinder and body would tear the equipment apart, because of the speeds involved.

To protect against this, we have developed a special bleeder valve which is mechanically actuated by the cylinder as it moves through its arc of travel. This valve diverts oil back to tank as the cylinder reaches the end of its travel.

• **Tripper system**—Stone, sand, and cement are hauled from a central plant in heavy motor trucks to the paver located at the point or points where the concrete is being laid.

Partitions divide the truck bodies into 4 or 5 compartments. Each partition is individually locked in position by a single rectangular cam. The cam is actuated by a hydraulic ram installed under the body directly below the partition.

The oil supply for the body hoist is utilized for operation of the tripping mechanism rams by means of a diversion valve. The body hoisting control is then used for releasing the rams. A manifold holding a series of valves is located on the truck dash, with each valve controlling a single partition. Movement of the valve from the *hold* to *release* position gives the operator both the sense of sight and touch to prevent double batching.

The remote control hydraulic tripper has been developed for use on the tandem chassis, using front telescopic hoists and carrying four and five batches. The use of the tripper permits a faster batching speed than is possible with smaller trucks and underbody-type hoists.

BATCHING TRUCK has compact trippers mounted under body floor. Dash-mounted knobs are connected to trippers by one-piece flexible lines.

J. C. LAEGELER,
Chief Engineer

The Frank G. Hough Co.

. . . One of the ways that mobile equipment manufacturers can reduce overall equipment costs is to use higher pressure systems, but before much can be done, the pump manufacturers, in particular, are going to have to make substantial improvements in their products. Manufacturers of hydraulic components have been slow to recognize the need for higher pressures in mobile equipment. The Frank G. Hough Co. has been a pioneer in the use of hydraulics, and for years we have been limited by the performance of components available to us. Pumps are probably the weakest part of the higher pressure picture. Until recently only a few models have been available in the 2000-psi class, and these have been relatively low volume units.

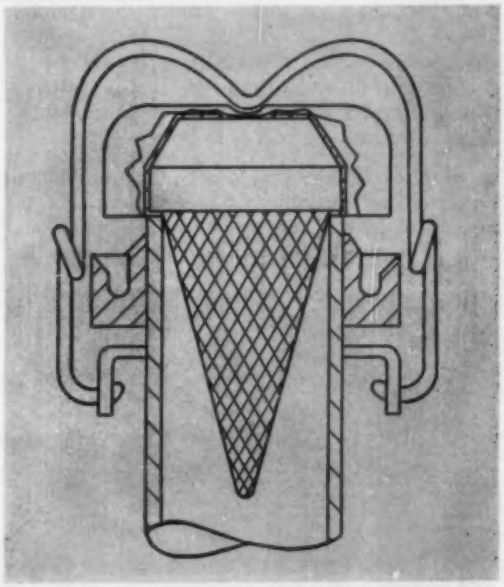
Mobile hydraulics is a field by itself, and manufacturers of components for *industrial* applications must recognize this. There are differences in performance, quality, and price requirements.

J. B. CODLIN
Vice President and Chief Engineer

Tractomotive Corp.

MOST RECENT ADDITION to the Tractomotive line is this wheel type, front-end loader. Frequently these machines operate in 110 F ambients so that temperature of the hydraulic fluid goes quite high. Packing data as well as data on all hydraulic components, should be available at temperatures in excess of 180 F.

. . . five filters including magnetic



CONE-SHAPED FILTER is installed at pump intake. Arrows show how fluid passes over magnet which holds ferrous particles. Other filters on reservoir openings and in return line help provide long pump life and efficient operation.

ONE OF the problems with packings is that accurate data on service life is not available. Information from the manufacturer should enable us to determine how long a packing will last. Life figures should be based on tests at 180F and higher instead of temperatures around 110F, because the packing will be required to perform most of the time at temperatures to 180 F.

• **Use five filters**—We are very strong advocates of filtering and have developed a portable filter for use on the assembly line to clean the hydraulic systems after final filling. This filter is also available to our dealers. The suction filter which we use on our front-end loaders has a magnetic filter as well as a cone-shaped screen. As shown in the figure, all fluid to the pump must pass over the magnet which retains all ferrous metallic particles. In addition, two micronic filters are installed in the breather and filler and a micronic filter is installed in the system return line with a 35-psi relief valve. This makes a total of five filters in our machine.

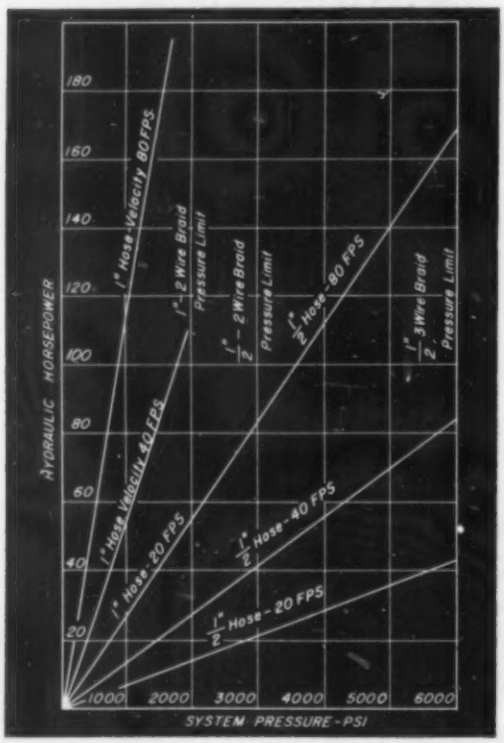
• **Valve reaction forces**—One of the improvements we would like to see in manually controlled valves is elimination of what we call *5th position*. This is the result of spool reaction forces and has the effect of holding or pushing the valve in one position other than the control position as it is actuated. It can disturb the operator's *feel* in controlling the machine.

We use accumulators for cushioning where this is specified by the customer. Not enough information is available on charging pressures and operating loads. Selection is too often a process of elimination.

. . . 6000-psi system — what does it offer?

THE MOST obvious advantage of this high pressure is that by increasing pressure four times over the usual 1500 psi, the same hydraulic power could be transmitted with one-fourth the fluid volume. This means that cylinder bore sizes could be reduced ½. Cylinder walls would have to be doubled to maintain strength. A point of caution is that the smaller cylinders would be more subject to column-buckling.

• **Smaller hoses**—Not only would the reduced fluid volume result in smaller line sizes, but the higher pressure would also mean a smaller *percentage* of pressure drop due to line friction. The curves show transmissible power plotted against system pressure, and represent the amount of power that a given size hose can transmit at the stated fluid velocity for any system pressure. For example, at 20 fps a ½-inch hose can transmit 42 hp. in a 6000-psi system. In a 1500-psi system, only 10.5 hp can be transmitted through this hose while maintaining the same velocity. The fluid velocities shown were selected because frequently 20 fps is the preferred maximum velocity for steady flow and a flow of 40 fps is often encountered during short time operation. Three-wire braid hose suitable for 6000-psi use is available through ½-inch size and has been proved in actual service.



CURVES SHOW AMOUNT OF POWER that can be transmitted at the indicated fluid velocity and hose size.

• **Better heat dissipation**—Because of the decrease in fluid volume, the heat dissipation problem becomes less severe for high pressure systems. This is true because for similar geometrical figures, the surface area varies as the 2/3 power of the volume. Thus as the volume decreases, the ratio of radiating surface area to volume actually increases.

Another advantage of the high pressure system is in the lower leakage rate of piston pumps compared to gear pumps. Of course there is a considerable difference in cost between these two types. Part of this might be off-set by an intensive development program. Increased usage would also help to lower the price of piston pumps.

• **Controlling leakage**—First objections which are raised in a discussion of higher pressures are leakage and filtration. Leakage can be successfully controlled by careful manufacturing and maintenance procedures. This means close fits to prevent packing extrusion, and good finishes to prevent packing wear. Pipe threads will probably have to be replaced completely by straight threads at 6000 psi.

At higher pressures, spool type valves are no longer practical, because clearances permit too much leakage. Most satisfactory valves for this service have been poppet type with lapped seats. Good filtration is a necessity and some difficulties have been caused by metallic particles lodging in the valve poppet seats. One answer is a filter in the pressure line, and development of these high pressure filters is progressing.

COMMERCIAL'S valve with 25% larger capacity and same cubage puts more energy to work

THE FASTER DIGGING and load discharge of the new Case® TerraTrac® backhoe is virtually in the lap of the operator. That's where a Commercial "Performance Rated" directional control valve is practically located. It is easy to control all the work. The operator stays fresh even at the close of a shift—works at high speed *all* shift to move more dirt faster. Here's how.

The hydraulic cylinders on the new crawler-mounted earth mover actuate the boom, swing, lift, crowd and bucket. The Commercial fluid power valves make 'em jump through a hoop right on cue because their throttling characteristics are extremely sensitive.

LOAD DROP ELIMINATED. A positive-hold check built into every operating manifold section of the valve eliminates load drop—regardless of the number of sections which may be in operating position. Return flow is blocked until the return pressure is overcome by pressure build up from the pump.

PARALLEL CIRCUIT BUILT IN. Another characteristic of the valve, a built-in parallel circuit, permits two or more cylinders to go through their paces simultaneously. This makes digging and unloading virtually one smooth, continuous operation. Faster backhoe action like this—so vital to schedule-conscious contractors—is further reflected in the valve's inherent reduced back pressure.

REDUCED PRESSURE DROP. Numerous design features in the Commercial valve have just about relegated the bugaboo of internal pressure loss to a back seat—as much as 25% back, in fact. Larger passage-ways of more uniform cross section, free from abrupt change of direction, and with smoother walls, plus solid spools without internal restriction, all give internal flow a big boost—put more fluid power to work. And with O-rings—instead of gaskets—for sealing between sections and at ends of spools, this fluid power stays right on the job at working pressures up to 2000 psi. With the kind of exact and precise timing action provided by the Commercial power control, "inching" loads to exact position becomes routine.

Still on the plus side, a built-in safety relief-pressure control insures added protection for the entire fluid power system and prevents over-loading the structural members of the equipment.

PERFORMANCE DATA AVAILABLE. If you have a need for precision control of fluid power, be sure you have the full story on Commercial's "Performance Rated" oil-hydraulic valves. It's easy to get. Just write to: Dept. A-49, The Commercial Shearing and Stamping Company, Youngstown 1, Ohio.

COMMERCIAL
shearing and stamping

CIRCLE 30 ON READER SERVICE CARD

WILLIAM O'SHAUGHNESSY
Sales Engineer

Tractor Equipment, Hyster Company

BACK HOE BUILT by Hyster is shown in a ditching operation. Controls are multiple valves of 1, 2, or 3 spools. Pressures range from 1000 to 1500 psi.

. . . relief valves to limit cylinder force

CLOSELY spaced ports on directional valves makes it hard to install fittings. We may have as many as six 1-inch hoses connected to a valve, and sometimes it is necessary to remove the valve first before applying a wrench to remove the hoses.

Another factor in valve ports is that they are too limited in variety of location, especially in valves from ¾ to 1 inch. In smaller valves this is not much of a problem, but it can mean extra piping in the larger units.

• **Hose wear**—Hose abrasion has been a problem for us, and we have noticed scuffing and wear of the Neoprene cover. While this is not detrimental to operation it can be objectionable. We have done some re-designing to eliminate this including filleting and grinding off sharp corners.

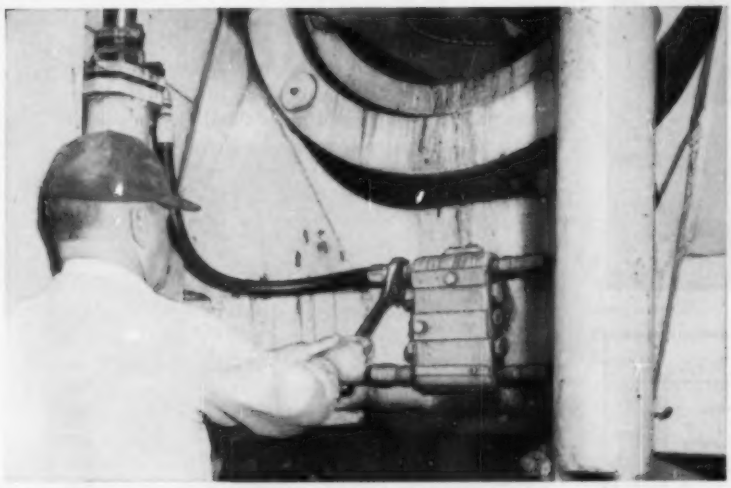
One reason for this rubbing is increased flexibility of hose at higher temperatures. When the system has heated up, the loop sags and interferes with other parts causing abrasion.

Column strength has been a factor in applying cylinders. We have had some trouble with cylinders acting in opposition with resulting damage, and we have added relief valves to limit cylinder forces.

Methods of attaching the piston to the rod has been a development project with us. The nut and lock washer which we used was troublesome and we have re-designed using a special nut.

Design Ease of Maintenance Into Mobile Equipment... Specify Aeroquip Hose Lines With Reusable Fittings

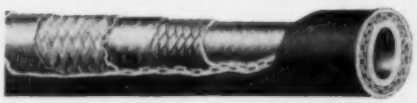
As original equipment, Aeroquip Hose Lines provide dependable performance plus low-cost replacement for equipment operators, because fittings can be reused again and again.



Hydraulic lines of any length can be replaced right in the field, using Aeroquip Bulk Hose and Reusable Fittings. Only ordinary hand tools are needed to make long-lasting hose lines.

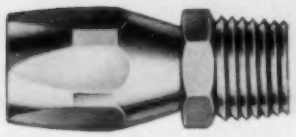
Make the advantages of Aeroquip Products added sales features on equipment you build! Aeroquip Hose Lines with Detachable, Reusable Fittings are known for dependable quality and fast field maintenance by equipment operators and distributors everywhere.

Qualified sales and service engineers are available to assist you with your hose line problems. Call or write for complete information, and ask for our new Catalog No. 201.

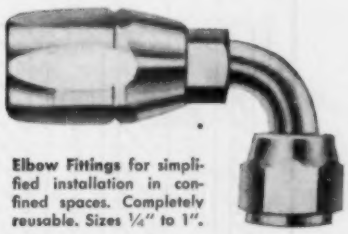


Single Wire Braid Hose for hydraulic, air, fuel and lube oil lines up to 3000 psi. Sizes from ¼" to 3".

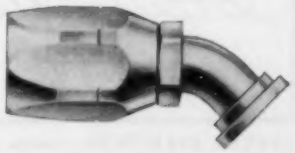
Double Wire Braid Hose for high pressure hydraulic systems up to 5000 psi. Sizes from ¼" to 2".



Detachable Fittings for all hose, in male pipe, S.A.E. and J.I.C. ends. Completely reusable.



Elbow Fittings for simplified installation in confined spaces. Completely reusable. Sizes ¼" to 1".



Split Flange Fittings for quick installation and removal of hydraulic lines. Sizes from ½" to 2".

Aeroquip

REG. TRADEMARK

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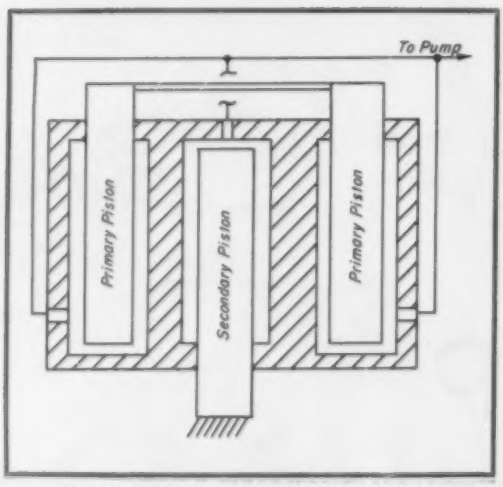
CIRCLE 3 ON READER SERVICE CARD

...develop a variable bypass valve for power steering

F. C. SCHUSTER
Chief Engineer, Material Handling

Buda Div., Allis-Chalmers Mfg. Co.



DUPLEX CYLINDERS provide the action of a telescoping design. This offers structural and space advantages on an industrial lift truck.

WE HAVE assisted in the development of duplex type cylinders (shown in the diagram) to provide "high free lift" and more flexibility in operating our fork lift trucks. We have worked with the packing manufacturers to determine the best material for the V-rings used in this type cylinder. Homogeneous rubber packings provide the best sealing with reinforced rubber packings next, and then leather.

• **Flow regulator in cylinder**—The displacement or ram-type cylinder has better column strength than piston-type cylinders. We have designed our ram-type cylinders with an extra port at the packing for returning leakage back to tank. We chrome plate all tilt cylinder rod surfaces and some lift cylinder rod surfaces. A flow regulator incorporated in the lift cylinder is a good safety device in case of line breaks.

Accumulators are an advantage when operating lift trucks on rough terrain to cushion the load, although the hose of the system gives some cushioning effect. We find that shock pressures are greater in the tilt circuit than the lift circuit and can reach as high as 300%, whereas shock pressures in the lift circuit range from 50 to 100%. One possibility for mounting an accumulator without requiring additional space on the truck is to incorporate the accumulator in the lift cylinder.

• **Bypass for power steering**—We have investigated various bypass valves to provide fluid for power steering. At present we are using a valve

which bypasses a constant flow. The ideal design would provide only the variable amount of fluid required, and we have tried a valve developed for this purpose.

• **Pilot-operated relief**—Relief valves have been a problem because of the large difference between cracking pressure and wide open pressure. Frequently where the relief valve is incorporated as a part of the directional valve there is as much as a 400-psi differential. We feel a good valve should have no more than a 10% differential. This is a limiting factor in load rating for our trucks, because if we are using a 1500-psi relief valve, we can only rate the truck for loads which can be lifted with 1100 psi. Pilot-operated relief valves which reduce the differential are becoming available as a part of directional control valves, and we are going to use them.

• **2500-psi pump**—Although we are operating at pressures somewhat lower than 2500 psi at present, we are thinking of higher pressures for the future. The greatest need is for components in the 2000 to 2500-psi range and higher. We have worked with manufacturers of gear pumps for this range and these are now available, but further development work must be done before these pumps are completely acceptable. We like the gear pump because it is quiet and its output is fairly smooth.

Valves present a problem at higher pressures. The spool type is economical and in large use at present. However, the poppet type seals better at higher pressures, although it is more subject to service troubles because of dirt. Pressure drop through valves is an important consideration, especially with gasoline trucks because the pumps in these units are running all the time, so that minimum power loss due to pressure drop through the valve is important.

. . . bigger motor-pump units

F. C. PARADISE
Barrett-Cravens Co.

RAISING AND HANDLING of long products such as these carpet rolls are powered hydraulically on this Crescent "Selectier."

What the battery-operated lift truck industry needs is a higher capacity motor-pump unit. The present ones available for 12/24 v work well, but we would like to see higher voltage and capacity units to satisfy requirements, such as lifting a 3000 to 4000-lb load at 50 to 60 fpm. The pump could be either gear or vane, but should be able to withstand 2500 to 3000 psi.

• **Valve size**—Cylinders for 2500 psi are no problem, but there will have to be some development work in producing pumps and valves for this pressure. The sectionalized valves which we use are rated at 1500 psi, but we operate intermittently at 2100 psi and should have valves rated for 2400 to 2500 psi. Space is also a problem with the presently available valves, with many of the units for higher pressures too big for installation on our equipment. Some units which do fit have too low a pressure rating.

In cylinders we prefer the ram type, single-acting units. Although they take somewhat more room than piston-type cylinders, they are less expensive because they require no honing. Also, there is less tendency to bind, although care must be taken to avoid damage to the ram because this would cause leakage.

. . . smaller relief valve differential for safety

HAROLD MILZ
Chief Engineer

Mercury Manufacturing Co.

SMALLER differentials between cracking pressure and full open pressure on relief valves would be an improvement in safety on industrial trucks. This would give better limitation of overloads. At present, operators will lift loads which are really too heavy. Although lifting speed is slower because some of the oil passes over the partly open relief valve, these overloads can be lifted under these conditions.

In some cases we have incorporated a safety switch mounted at the back of the truck to protect against lifting loads which are too heavy. If the rear of the truck lifts, the switch is actuated to shut down the pump drive motor and prevent forward travel.

• **Speed control**—Better throttling control on directional valves is a feature we would like to see improved. A fork lift truck has the contrasting requirements of fast lifting—sometimes as fast as 60 fpm—and slow tilting, especially with large loads. At present we are using meter-in orifices to control speeds, although these reduce efficiency.

Until recently we have had to use an external arrangement with our directional valves to actuate switches controlling the pump motor which operates only when the hydraulic valve is actuated. However we are now able to purchase valves which have an extension which actuates the switch.

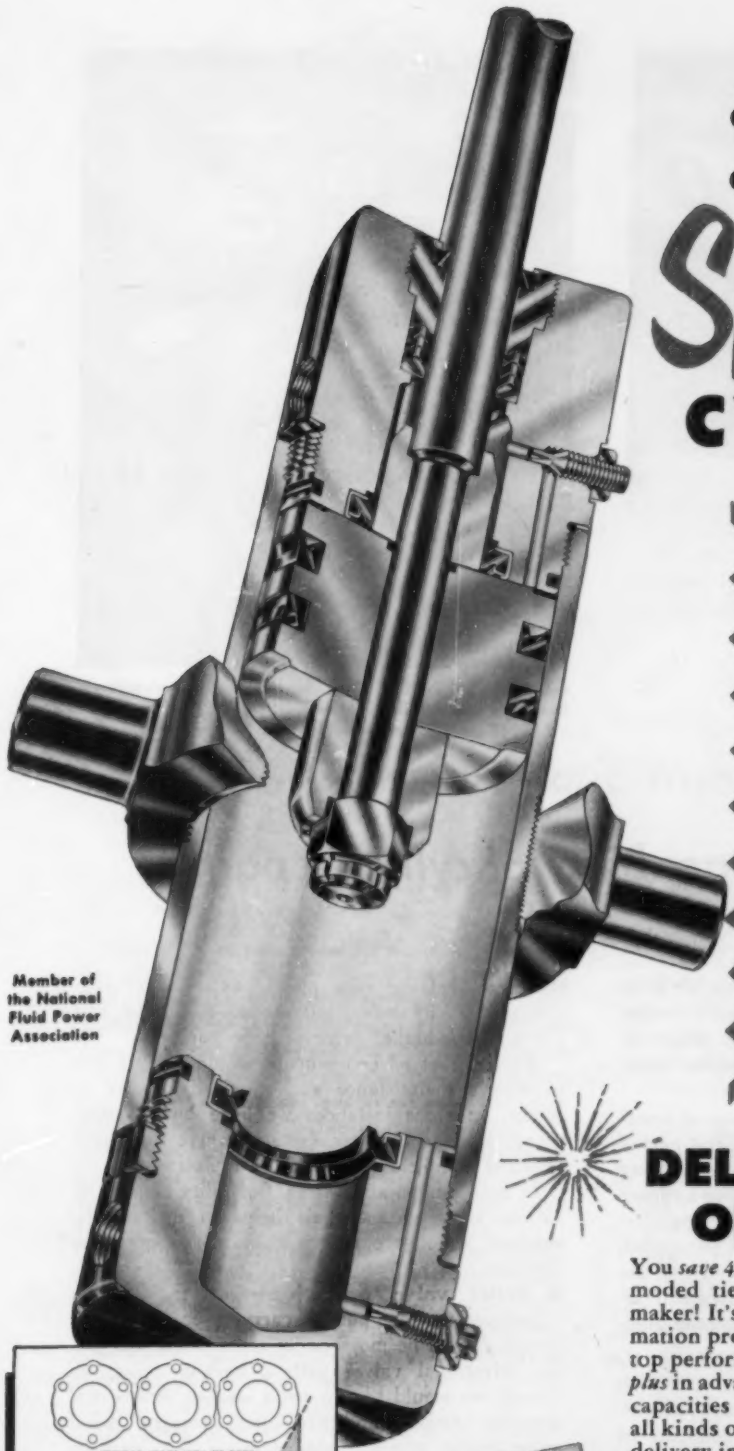
• **Higher performance pump-motors**—There are improvements to be made in pump-motor units, and we feel there is nothing available today in the quality and performance we would like to have. With battery-operated trucks, a high efficiency is required and we need a motor unit with at least an efficiency of 80%. With improvements in efficiency and lower cost variable pumps, the all-hydraulic truck may be the coming thing. We have experimented with such a model.

• **Variable volume pump**—Almost all manufacturers of industrial mobile equipment would like to have a variable volume pump at a price they could afford. We believe this will be developed, and we think this kind of project must be a joint effort between the pump manufacturers and the machine manufacturers.

Higher pressure components are in the picture also. We are now operating at 1000 psi and are considering going to components rated for 2000 psi. This would mean a big savings in size, although there would probably be little savings in cost because of the higher precision necessary in components for higher pressures.

HYDRAULICALLY OPERATED ROTATING ATTACHMENT on this Mercury "Yank" fork truck dumps forgings into the hopper of a sand-blast cleaning machine.

all the EXTRAS are standard with T-J Spacemaker CYLINDERS



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- **STRONGER** than outmoded tie rod design, proven through actual tests. No tie rods to stretch.
- **SOLID STEEL HEADS** throughout the full line.
- **COMPACT DESIGN** eliminates tie rods, increasing the strength and reducing mounting space required, providing extra room for adjacent equipment.
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- **PILOTED PACKING GLAND** with extra long bearing. Additional strength and support to the piston rod.
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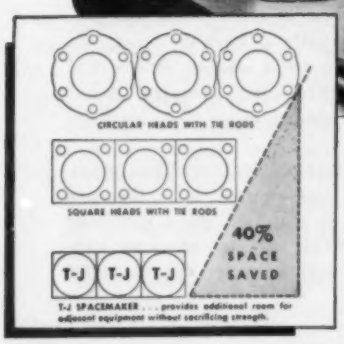
CIRCULAR HEADS WITH TIE RODS
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T-J SPACEMAKER . . . provides additional room for adjacent equipment without sacrificing strength.

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You *save 40% space* when you switch from outmoded tie rod cylinders to the T-J Spacemaker! It's stronger, too! Fits right into automation programs in countless plants. Delivers top performance and dependability with a big *plus* in advanced features. Wide range of styles, capacities . . . reduces man-hours and costs in all kinds of push-pull-lift operations. Off-shelf delivery in 64,000 combinations!

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DIVITORS . AIR AND HYDRAULIC CYLINDERS . CUTTERS . CLINCHORS

EDWARD SIROTAK
Chief Research Engineer

Baker-Raulang Company

GASOLINE ENGINE fork truck for indoor-outdoor handling has 4000-lb capacity. Sealed relief could be an excellent feature on machines such as this.

. . . interchangeability of cylinder parts

ONE FACTOR which will increase pump life is to reduce fluid foaming. This causes cavitation and pump wear. Part of the answer is in designing reservoir baffling: part of it is in developing better anti-foam fluids.

• **Integral reservoir**—In the same area of reservoir design, a reservoir which is an integral part of the truck frame and which incorporates baffling and a filter would be desirable. In addition to space saving, this would also increase reservoir capacity. Welding the reservoir to the frame has been tried, but resulting leaks which were discovered too late made this too expensive. Welding spatter and inability to clean the weld properly, presented additional problems.

In fluids we would like to be able to buy a non-flammable fluid which has anti-foaming characteristics, has no effect on packings, and can be used at temperatures from —30 to 110 or 120 F. The present water-base fluids which we are now using do not have this temperature range.

• **Gear versus vane**—Fluid power pumps for mobile, electric-powered equipment should have greater efficiencies. We are using gear pumps and recognize that the vane pump has a higher efficiency in many cases, but we do not think this warrants the higher price of vane pumps.

We feel that all components should require less preventive maintenance and should be easier to repair. In some instances we have had to send pumps back to the manufacturer where they have required complete rebuilding or replacement.

In both pumps and valves, flexibility of port locations is important. This helps in making the shortest, simplest connection and helps minimize line loss.

• **Relief valve operation**—Our maintenance considerations on pumps carry over to valves. Spools should be more easily replaceable. We prefer directional valves with a built-in relief, although we would like to see a smaller differential between cracking and wide-open pressure. Relief valve reseat pressure should equal the cracking pressure.

We think that the sectionalized valve has many good features, but its disadvantage is in the care required in handling to maintain good matching surfaces. A marring of this surface can cause leakage after assembly. Better protection for the valve

sections could overcome this. Remote controlled valves which incorporate throttling will help in operation of attachments where the operator is stationed with the load. Present valves which we are actuating with pushbuttons have no such speed control characteristics.

• **Sealed relief valves**—Relief valves should have some type of seal to prevent tampering by unauthorized personnel. Instead of the common handwheel or screwdriver adjustment this should be designed for some type of uncommon tool. The pressure adjustment should also be designed to prevent complete bottoming where the relief valve will not open under any pressure.

We are making our own cylinders because of the lack of interchangeability of parts in cylinders from commercial suppliers. If we were to buy our cylinders we would have to have at least two sources, and parts would have to be interchangeable to comply with our service program. Packing manufacturers have made progress in interchangeability.

We have a similar problem in changing over to straight thread fittings, although we realize their advantages in assembly and controlling leakage. Our trucks sometimes are operated for as long as 25 or 30 years, so that any such major change as going to straight thread fittings and ports presents problems in stocking. We do feel that straight threads could permit smaller components, since much of the bulk in present components is required because of the stresses applied with pipe thread fittings.

• **Compact power steering**—The power steering equipment which is available to our industry has too many components. We would like more compact units especially for our larger trucks such as the 10,000-lb side loader. The ¾-inch priority valve which we are now using to divert 3 to 4 gpm for steering could be improved in respect to pressure drop. This is especially important during pump unloading when power loss in the valve is appreciable.

We are using hose for almost all of our lines because of the flexibility it offers in redesigning our machines or in modifying them in the field.

. . . hydrostatic transmissions

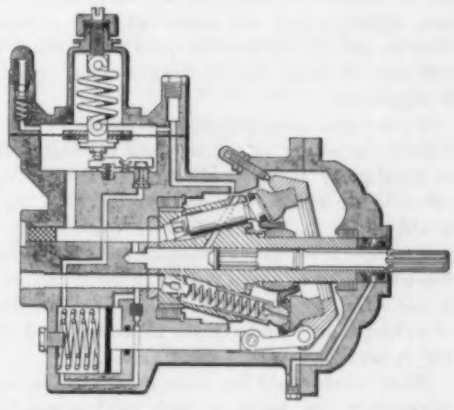
From Birmingham, England, O. N. Lawrence, Technical Director of Joseph Lucas Ltd. reports:

Hydrostatic transmissions for variable speed service on mobile equipment have been the subject of a good deal of discussion lately. It may interest readers to know that we have recently driven three different designs of vehicle employing such hydrostatic transmissions, and we are confident of their future. Although everyone seems to agree that they have many virtues for this type of service, the matters of cost and efficiency of pumps and motors are usually suggested as the reasons why this type of transmission device is not more widely used.

A good axial piston pump which overcomes both of these objections is available. A good pump will, of course, make a good motor, with slight modifications—and in many cases simplifications. However to save gearing, it may sometimes be preferable to use large wheel motors as in the N.I.A.E. tractor.*

The pump mentioned is available in a range of sizes with capacities from 1 to 60 gpm per 1000 rpm. For highest efficiency, maximum operating pressure of 3000 psi is recommended. Overall efficiency over a wide speed range is 93%. Pumps have fully variable stroke, and are reversible.

These pumps are an outgrowth of fuel pumps for aircraft. In this service, they handled gasoline and kerosene at pressures to 2000 psi without the use of any oil or other lubricant. Although life in such service would be expected to be very short, units in air line service are untouched for 2000 hours. Such units on combat aircraft in Korea stood up well despite the dirty fuel encountered under such conditions.



HIGH PERFORMANCE PUMP. Rotor body carries separate pistons which are formed with *slippers* attached by a ball joint. Slippers bear against an inclined cam plate which remains stationary.

* APPLIED HYDRAULICS Dec. 1956

B. I. ULINSKI,
Director of Design and Development

J. TISKUS
Asst. to Director of Design and Development

Automatic Transportation Company

. . . prefer rotary and poppet type valves

WE PREFER rotary, flat-plate, shear seal type valves for our machines which operate at 2000 to 3000 psi. We have found that the rotary valve has less leakage than a spool valve at these pressures. Full flow characteristics are better and valve reaction forces are minimized. Rotary valves are not as sensitive to dirt, and they are easy to maintain, although they are somewhat more expensive. Also we are able to throttle speed much better with this type of valve, and *inching* on our equipment is important.

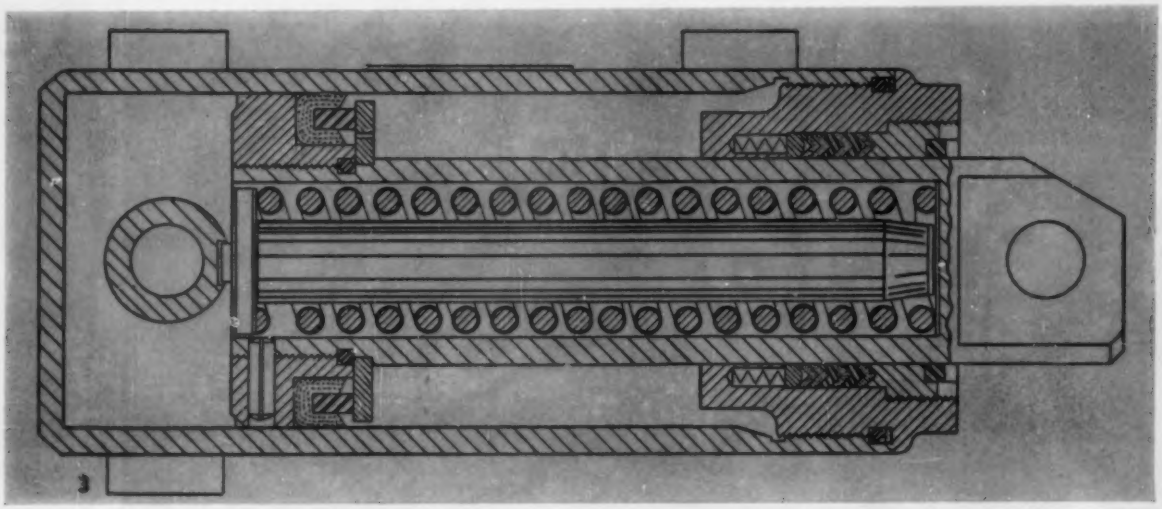
We are also using poppet-type valves for flows to 4 gpm; the rotary valves are used for higher flows in sizes up to 15 gpm. Manually operated poppet valves work well for throttling operations, but we would prefer a motorized valve for remote controlled operation of attachments on our machines. We use a pilot-operated poppet at 3000-psi, because it has advantages of good sealing and prevention of cylinder drift under load. However good filtering is necessary with poppet valves.

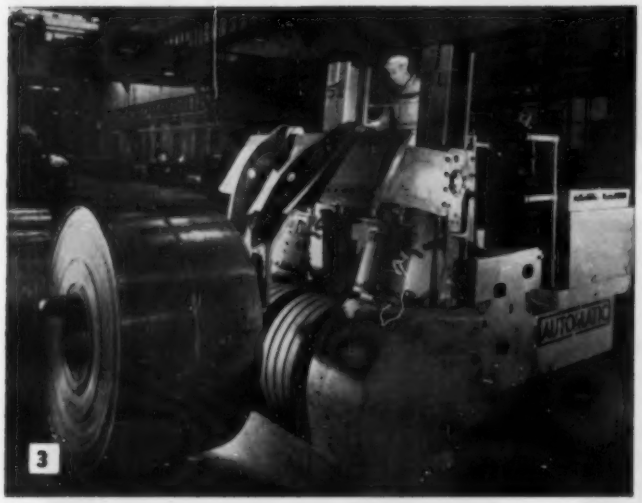
More work could be done by the valve manufacturers in the design of their mechanisms to actuate electrical switches starting the electric motor on battery operated trucks. Only one company we know of has done any extensive work in this regard.

- **Fixed relief valves**—One difficulty we have had with trucks in the field is that operators change relief valve settings to pick up overloads. To discourage this practice we have changed the relief valve adjustment from a screwdriver fitting to one requiring an Allen wrench. Probably the best answer is to eliminate manual adjustment entirely.
- **3000-psi pump**—One of our big requirements is for a 3000-psi pump which is compact. Size of our trucks is limited because of the limited areas in which they must work and the need for maneuverability. We are having some difficulty with the present pumps we are using for higher pressures, and have experienced shaft shearing, bearing wear, and other damage due to shock and overloads. We have had trouble with unbalance of pressure plates in gear pumps. This results in undue and uneven wear.

We would like to see standardization of pump mounting flanges. There is a problem in hole spacing and location of the alignment pin from one pump manufacturer's products to another.

We have designed our reservoirs to accommodate a suction filter and also use a 40-micron high pressure line filter placed ahead of the directional valve. Suction filters are of both the wound-ribbon type and the 100-mesh screen type.





1

AUTOMATIC'S NEW LIFT TRUCK for loads from 12,000 to 20,000-lb is demonstrated by Brownie Ulinski and Jerry Tiskus. Built-in retraction feature maintains maximum stability throughout the 120-inch lift. Tilting action is operated by a single control lever which controls tilt and lift separately or simultaneously.

2

SPRING-LOADED CYLINDER designed by Automatic has a fixed rod, movable cylinder. Piston packing is U-ring. Rod packing is spring-loaded V-ring assembly.

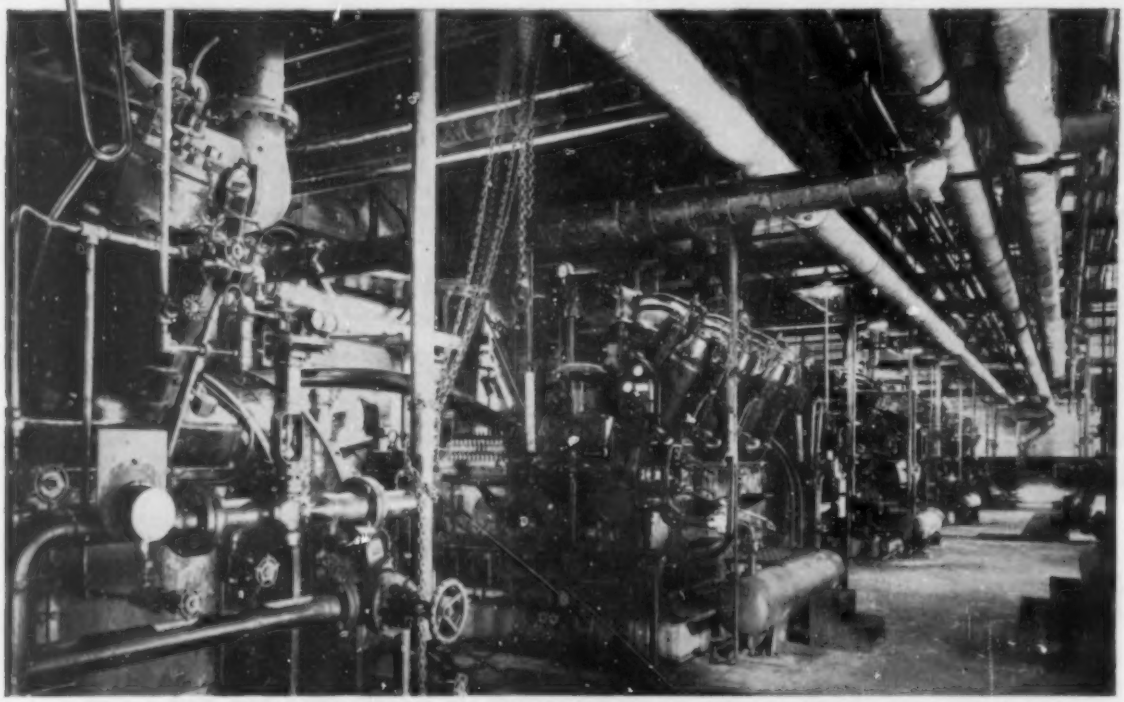
3

HEAVY DUTY TRUCK has coil handling attachment. Hydraulic system will handle 15,000 pound load.

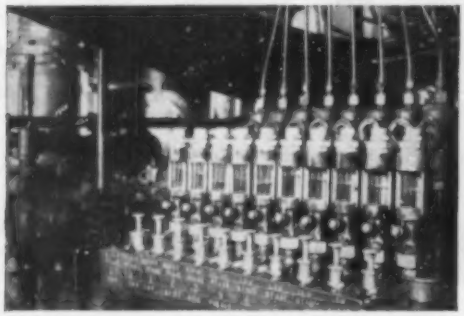
• **Flare fittings for maintenance**—We are using both compression and flare fittings on our hose and tubing assemblies, but find that the flare is best from the maintenance standpoint and is the most economical. We have a special department for bending and flaring tubing where master tubing assemblies for each model are stored with the dies to form them. We use seamless steel tubing, although we did try rolled tubing with flare fittings. This resulted in some leakage because of inexperience, or otherwise the tubing would not flare uniformly. Although we use a considerable amount of tubing, we do prefer hose where possible because of its flexibility, and shock absorbing qualities especially where lines are long.

Dryseal pipe threads have worked quite successfully for us, and while we recognize the features of the newer straight thread fittings, we do not believe they are the complete answer to leakage control. We know of some designers who have adapted the straight thread fittings and then switched back to pipe threads.

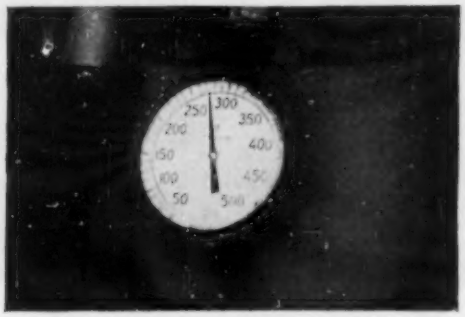
For information about the most complete fluid power reference source under one cover, see page 15. Design of mobile equipment systems is one part of this 800 page handbook.



"... Cellulubes were tested for two years in four Cooper Bessemer Air Compressors. Cylinder wear was negligible. Deposits normally found in compressor auxiliaries and valves were reduced or eliminated."



"... A conventional lubricator will pump Cellulubes satisfactorily. No obnoxious vapors—does not present a personnel problem in terms of handling a toxic material."



"... No pressure surges nor evidence of fire in the air accumulator when Cellulubes are used. They are excellent lubricants, and also are effective as detergents."

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From a trial file covering two years testing in Cooper Bessemer 3-stage air compressors

"NO PRESSURE SURGES...NO EVIDENCE OF FIRE... EXCELLENT LUBRICATION...WHEN FIRE-RESISTANT CELANESE CELLULUBES ARE USED!"

"Cellulube has now been in four of our Cooper Bessemer air compressors for approximately two years. The compressors were inspected during a recent Catalytic Reformer General Inspection. Cylinder liner wear was negligible, particularly when compared to the amount of wear we had experienced when previously using a synthetic lubricant. Cellulube, in addition to acting as a lubricant, is also effective as a detergent. Compressor cylinder air passages which had been heavily coated with carbonaceous materials and deposits laid down by the previous synthetic lubricant, are gradually being removed and the compressors again show the original factory finish. Deposits on valve cages and plates have been reduced and are no longer a problem.

"Cellulube does not present a personnel problem in terms of handling a toxic material. There are no obnoxious vapors from Cellulube. A conventional lubricator will pump Cellulube satisfactorily.

"There have been no pressure surges nor evidence of fire in the air accumulator.

"We believe this material is an excellent lubricant plus the fact that acting as a detergent the deposits normally found in compressor auxiliaries and valves have been reduced or eliminated."

These results are typical of what you can expect from Celanese Cellulubes. They have been developed to meet the pressing need for fire-resistant lubricants which virtually eliminate the problem of carbon deposits.

Celanese Cellulubes are available in 6 controlled viscosities: 90, 150, 220, 300, 550, 1000, S.U.S. @ 100° F. These straight phosphate esters provide excellent lubricity, are non-corrosive and non-reactive.

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CIRCLE 26 ON READER SERVICE CARD

CELANESE CELLULUBES

JOHN A. DRAXLER
Assistant Chief Engineer

Elwell-Parker Electric Co.

. . . more detailed component specifications

HIGHER speeds and consequently higher power levels require an intensive development program to raise the efficiency of the hydraulic system. We have used many methods to increase efficiency on our battery-operated trucks, but at present an overall efficiency of 50% from the input to the pump motor to the final hydraulic output is considered good.

• **Better specifications**—What we are working for is a better balance between the driving motor and the pump, and to achieve this we must have more thorough test results and specifications from the component manufacturers. Pump rating may state that the pump will deliver 5 gpm at 2000 rpm and 1000 psi, but what are the effects of oil temperature, and what is the delivery at other speeds and pressures?

Three pumps from different manufacturers may have the same catalog rating, but may have entirely different characteristics at other speeds and pressures. One pump operating at 90 F may have an output of 6 gpm, and an output of 4 gpm at 120 F. Another pump of the same rating may have the same output at the lower temperature, but may deliver 5 gpm at 120 F.

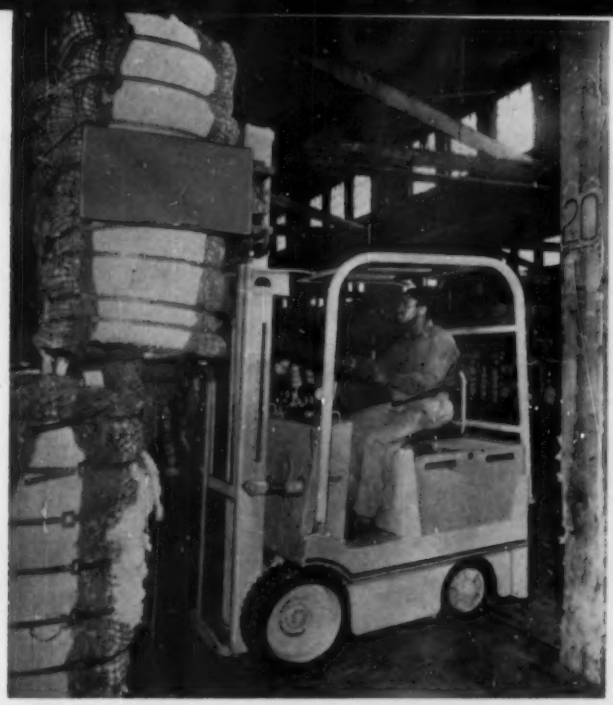
These are facts we must have because of the varying loads and pump speeds in a lift truck. The pump must supply cylinders for lifting, tilting, clamping, rotating and often other operations. Each of these represents a different load with different pressure and power requirements. In addition, much of the lift cylinder operation is under no-load conditions. Since what goes up must come down, the forks must go up empty to get it.

• **D-C motor speed varies**—Pump speeds in a battery operated truck vary with pressure because the d-c motor slows down with higher torque requirements. A motor may run at 2200 rpm under no-load conditions and slow down to 1000 or 800 rpm under full load. This adds to the need for complete specifications.

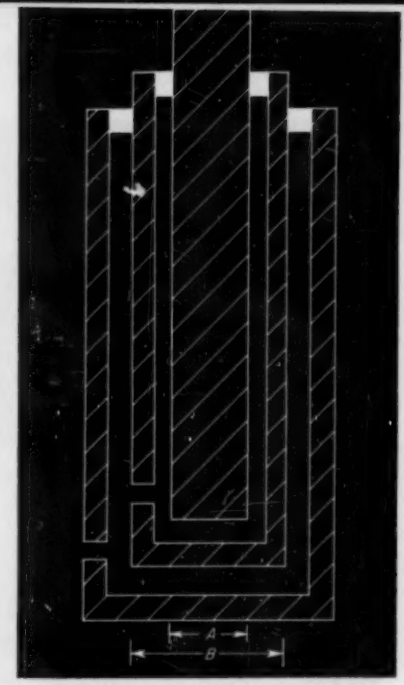
We have set up an extensive testing program to obtain the kind of component information we need to improve our products, but we feel that this is the kind of project which should be undertaken by the component manufacturers themselves. Complete testing of a component can take up to 3 months, so that once we have obtained information on one manufacturer's product, it is difficult to consider another source, even though we appreciate the value of several suppliers. We feel that if a second manufacturer wants us to use his product, he must present it with the same type of information that we have obtained by test.

• **Have increased efficiency**—The results of our test program have already been helpful in our design. In some cases, by going to a different pump, we have actually gotten greater pump output and speed with less input power to the motor. This was simply a matter of one pump having better output characteristics at the particular speed and pressure required.

We have been able to increase efficiency as much as 25% by better balance between motor and pump. Other steps can also lead to higher efficiency. On traveling attachments, the use of rollers instead of slides has reduced friction. In a clamp attachment of another manufacturer, we cut power requirements from 160 amperes to 105 amperes by increasing hose size and eliminating a T-connection which was restricting flow. Not only did we decrease input power, but the operating time was cut from



ZERO LEAKAGE is a requirement for trucks handling material such as this cotton. Close cylinder tolerances and separate drain lines for leakage have helped accomplish this.



DISADVANTAGE OF TELESCOPIC CYLINDER is increased speed and pressure as cylinder extends.

10 seconds to 4. This is typical of what can be done to reduce the power demand on the battery.

• **Design for leakage control**—Battery-operated trucks are frequently selected because of their cleanliness, so leakage in the hydraulic system must be carefully controlled. This is a factor in considering higher pressures. There is no doubt that the leakage problem will be greater, but it will be solved, and 2000 psi seems to be the future pressure in our thinking. We have drain lines on all our cylinders and on other hydraulic components to return leakage back to tank.

Because of their high ratio of extended length to retracted length, telescopic cylinders are basically good for our equipment. However there is room for improvement in balancing out the increased pressure and speed as the cylinder extends. Referring to the diagram, it can be seen that this is most objectionable in smaller cylinders where the ratios between *B* and *A* are higher. For instance, if *A* is 8 inches and *B* is 10 inches, then speed and pressure increase by a factor of 100/64 as the larger section completes its stroke and the smaller section begins its stroke. In a smaller cylinder, if *A* is 1 inch and *B* is 2 inches, speed and pressure are increased by a factor of 4/1. This speed increase is especially objectionable in lifting, because slower speeds are desirable for stability as the load reaches its maximum height.

• **Smooth speed control**—No directional control valve is available to give us the smoothness of throttling we need. Actually the valve handle *can* be carefully manipulated to give smooth throttling, but many operators will not develop this kind of *touch*. The average spool travel in a valve is 3/8 inch. We have designed linkages in some instances to permit greater travel of the operating lever, but usually there is no room for these linkages. We would like to see spool strokes increased to about 1 inch. Possibly the sliding-plate type of valve is an answer to better throttling, although these are not available at present in sizes for our applications.

• **Compatible packings**—Can a fire-resistant fluid be developed which is really effective, and yet which is compatible with the same packings as petroleum fluid? Synthetic fluids have had the greatest acceptance, but the necessity for special packings complicates their use. We must order special components equipped with the proper packings, or we must replace the packings ourselves. Delivery is a factor in ordering the special components, and manufacturing facilities must be geared for replacing packings. Stocking of parts is also a problem when special packings must be used, and price can be very high.

Teflon may be part of the solution as a universal packing which can be used with both petroleum and synthetic fluids. However, further development must take place before this material is used for O-rings.

• **Low pressure seal**—Because of the high percentage of no-load duty on our cylinders, seals must work well at low pressures as well as high pressures. We have tried a spring-loaded arrangement of V-rings, but found that replacement was required more often than without the spring. This was probably because the spring-loaded seal did not permit tightening to eliminate leakage but had to be replaced. Of course, the advantage of the spring-loaded type is that it prevents overtightening.

CARL FRELLSEN
Chief Hydraulic Engineer
Joy Manufacturing Company

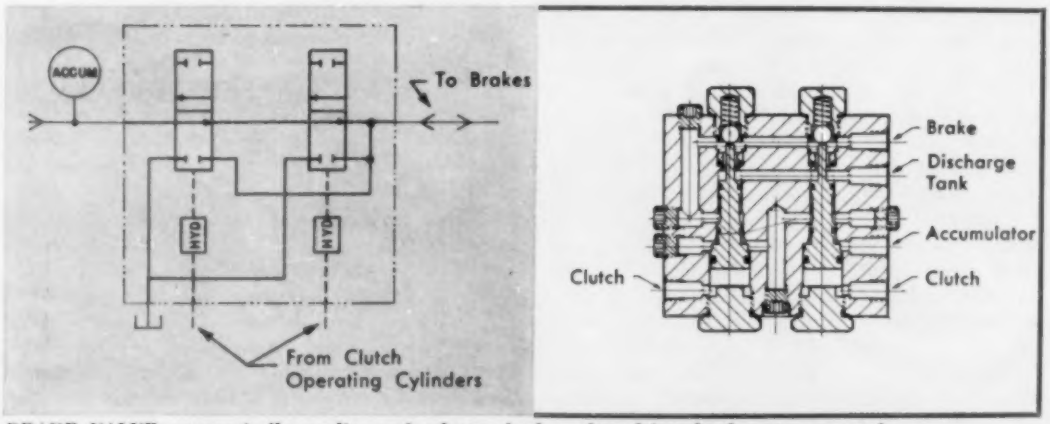
. . . flexible hose of synthetic rubber put hydraulics in the mines

OUR SELECTION of components is based on flexibility of application, while providing a good measure of standardization for good availability and reasonable cost.

Our experience has shown the gear type pump and motor to be quite adequate for mining machinery, and we use these units in a wide range of gear sizes, as well as in tandem, triple, and even quadruple pumps. We find that these pumps have good advantages in size and maintenance. Because we can interchange gears and other parts to vary capacity, they give us flexibility when changing designs.

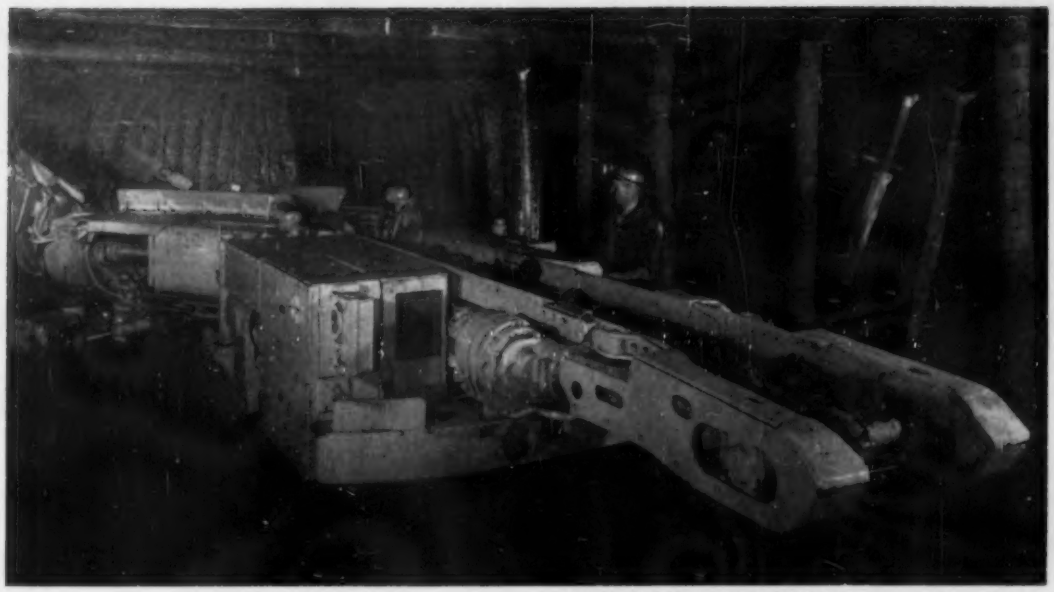
We use sectionalized, spool-type, directional control valves in many different combinations, and in single and double circuit assemblies.

We have designed manifold-mounted relief valves having a common return line, when we found that the piping for 8 relief valves would have been ex-



BRAKE VALVE automatically applies and releases brakes when drive clutches are operated.

Courtesy Fluid Controls, Inc.



CONTINUOUS MINER for high seams has capacity of 4 tons per minute. All piping and wiring are run through the center of the machine in the turntable, keeping hose and wire movement to a minimum when swinging.

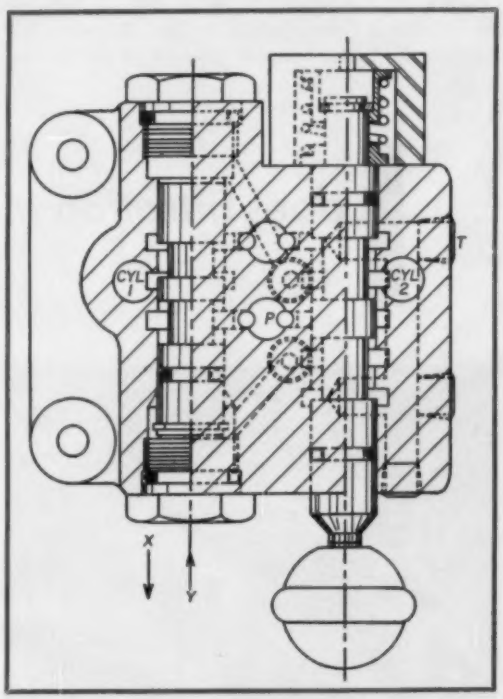
cessive. We got the idea for this from our experience with multiple directional valves.

• **More fluid motors**—The use of hydraulic motors is on the increase. Although the overall efficiency in transferring electrical energy to hydraulic energy to mechanical energy is low, the flexibility of control, easy reversibility, elimination of clutches, and simplicity of obtaining a braking effect make fluid motors attractive for many applications on mining machinery. One problem of the reduced efficiency is in dissipation of heat from the oil.

We work in the 0 to 1500-psi pressure range and find it adequate for most applications. High pressure circuits do offer increased efficiency and a wider range of working pressures for motor applications, and we now have several machines using pressures to 2000 psi. We recommend the use of a 90-viscosity index, 300 to 325 viscosity oil with anti-foam and anti-rust additives. Aniline point should be 200. Our circuits and our suction filters are chosen for oil with these specifications.

• **Special clutch valve**—A problem which arose on one machine was in disengaging the conveyor clutch which was actuated by a cylinder. Operators usually actuated the control valve only momentarily, so that frequently the clutch was not disengaged completely. The dragging clutches were burning out. A special valve shown in the figure was developed so that momentary operation of the valve handle would prepare the circuit to hold pressure on the rod end of the cylinder for complete disengagement.

Pulling the knob out directs fluid to the CYL 2 port and the head end of the clutch cylinder, engaging the clutch. This also applies pressure to shift the valve pilot spool in direction *X*. Releasing



MOMENTARY ACTUATION of this clutch valve insures complete disengagement of the clutches.

the knob allows the spring to center the spool and connects both cylinder ports to tank. Both ends of

CARL FRELLSEN . . .

the pilot spool are also connected to tank.

Pushing the knob in applies pressure to shift the pilot spool in direction *Y*. The pilot spool remains in this position after the knob is released holding pressure on the CYL 1 port and the rod end of the clutch cylinder.

• **Special brake valve**—In designing equipment for hard rock mining, a problem arose requiring development of a special brake valve. Crawler-mounted equipment used in coal mining works well because of the lubricating characteristics of coal dust which provides a film between the crawler shoes sliding against the frame. However, in developing a machine for hard rock mining, designers knew this lubrication would not be present, so rollers were provided between the crawlers and frame. This raised the problem of braking the machine against loads. For instance in the case of loaders, if the operator forced the arms into a rock pile, the machine would have a tendency to move back instead of remaining stationary.

The brake valve developed with Fluid Controls, Inc., automatically applies and releases the brakes when the drive clutches are operated. The valve directs fluid to the brake cylinders whenever both clutches are disengaged. If either one, or both, of the clutches are engaged, the brake valve shuts off fluid to the brake line and connects it to the reservoir port. This eliminates the need for a manually controlled brake valve and insures that the brakes are applied whenever the machine is not being driven.

• **Designing cylinders**—Cylinder applications must be designed with an understanding of conditions in the mines. Corrosion is a big problem. Chrome plating cylinder rods is one of the answers, and we use a process to put a layer .003-inch thick where the normal plate is only .0005 to .0007-inch. We have also used stainless steel rod-and-piston units on smaller cylinders.

We have found, on our type of equipment, that the simplest way to avoid cylinder alignment problems is to provide a loose fit on the pins and the lugs. This permits the cylinder to align itself with the load.

• **Fire-resistant fluid problems**—We've given a lot of consideration to the fire-resistant fluids and have assisted the U. S. Bureau of Mines in their investigations of hazards and fluid usage. Cost is still a big factor; the water base fluids are the most promising from the cost standpoint. However, temperatures on mining equipment run to 175 F and temperature of water base fluids is limited to 150 F. Vaporization is a problem with these fluids, although some means of condensation might be worked out. We are not convinced of the compatability of these fluids with the dirt and conditions in the mines.

. . . does filtration mean starvation?

FRANK VALLA
Assistant Master Mechanic

Harwick Mine, Duquesne Light

WE'RE INTERESTED in filtering our hydraulic oil, but not at the expense of starving the pump. Getting the very maximum pump life by complete filtering is not our objective, rather we'd like to increase pump life several months by eliminating starvation which is the biggest cause of pump failure. Filters can clog quickly, and too often they're thrown away rather than replaced, just to keep the machine running.

• **Filtering too fine?**—We've done some experimenting with edge-type filters which leads us to

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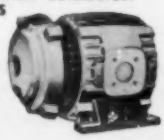
Protected **AGAINST CORROSION ALL EXPOSED PARTS CAST IRON...**

Rust-resistant solid cast iron withstands abuse, wear and corrosion. *Protects* working parts!



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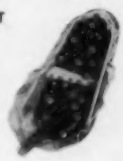

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Large savings are being gained by many industries using *enclosed* motors in place of the usual "open" or ordinary protected motor. U.S. Totally Enclosed gives *total* protection in every direction—from corrosion, dusts, abrasives, impact, weather, spray and splash! This means motor dependability ...long life...savings both on motor costs and production continuity!

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FRANK VALLA . . .

believe we may be trying to get too fine filtering. By putting a vacuum gage on the pump intake of a machine having 6 feet of hose between the pump and reservoir, and suction filter, and a fluid rise of 18 inches, we got a reading of 22 feet of water. Removing the filter and checking again with the reservoir at pump level, we got a reading of 3 feet. We then removed about 10% of the plates from the filter and replaced it. This gave a reading of 8 feet. Further refinements of raising the reservoir 1 foot above the pump and shortening the hose to about 18 inches reduced the vacuum reading to 5 feet of water. In all tests, inlet hose was 1 inch. The result of this has been to increase average pump life from 2 months to 7 or 8 months and emphasizes the importance of free intake flow to the pump.

• **Relief valve operation**—Hose blowout has accounted for 75% of the hydraulic failures on mining equipment. Probably some of this is due to improperly assembled hose fittings; probably some is due to abrasion. However, we suspect that a lot of our trouble is caused by the slow action of relief valves under shock pressures. Loading conditions for mining machines are certainly far from constant and shocks are frequent as mining machines strike hard sulphur balls in the coal face or conveyors stall against the roof. Some methods for reducing shock, such as use of accumulators, are not practical on mining machines where space is limited. Perhaps placing a relief valve close to the cylinder where the shock wave begins would be a solution.

• **More rugged pumps**—We realize the space limitations, but would like to see pumps built more ruggedly. In our opinion, shafts are not large enough, and keys and splines are too light. Sometimes a fast decision must be made in the mine to raise the pressure relief valve setting because of harder coal, even though this means shortening pump life. We'd like to be able to operate on overloads for short periods without having the pump go bad.

Chrome-plated cylinder rods are very important in the mines because of the moisture. We've been troubled with a peculiar scoring on our single-acting rams, although this appears to be caused by some type of electrolysis rather than a mechanical action.

. . . stainless steel for piston rods

R. G. WILLIS

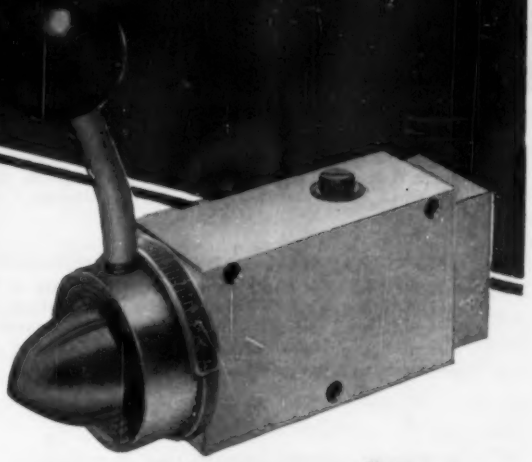
Galis Electric & Machine Co.

IN OUR repair and rebuild operation, we see the results of abusive use of mining machines. While this is caused by a combination of conditions in the mines, there is no doubt that better maintenance would result in longer life and higher production of overworked equipment.

Hydraulic components used on mining equipment are usually overloaded and this shows up on the bearings and other surfaces. Pumps with more bearing contact give longer life and we have found that barring foreign material in our oil, we can expect satisfactory service until the bearing or bearing surface is worn .003 inch.

Continued on page 100

For SAFE, DEPENDABLE ENGINEERED for DURABILITY... CONTROLS



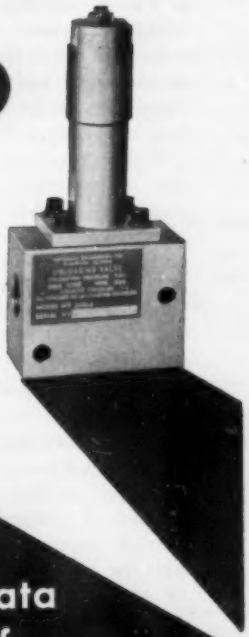
CONSULT WATERMAN

Waterman controls are known for their accuracy, dependability, safety, and low maintenance cost.

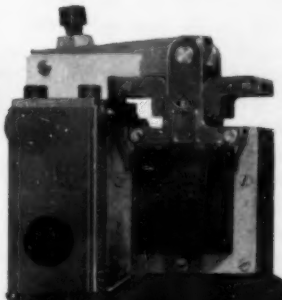
Adjustable Flow Regulators range from 0.5 GPM to 20 GPM. They maintain a constant rate of flow regardless of resistance or pressure fluctuations.

No. 1. Check Valves are one piece, Nylon Poppet, aluminum body and low pressure drop.

No. 2. Micronic Line Filters have operating pressures to 3000 psi, 40 micron filtration, replaceable elements, and are available in ⅜" and ¼" NPT.



No. 3. Solenoid Valves are inexpensive compactly built units for hydraulic systems handling non-corrosive fluids. Capable of continuous operation for working pressure to 3000 psi.



No. 4. Unloading Valves for pressures to 3000 psi. Flow rates to 30 GPM. Fast acting, maintain desired pressure without continuous readjustments.

Send for Bulletin A

Write for data on any of these WATERMAN products

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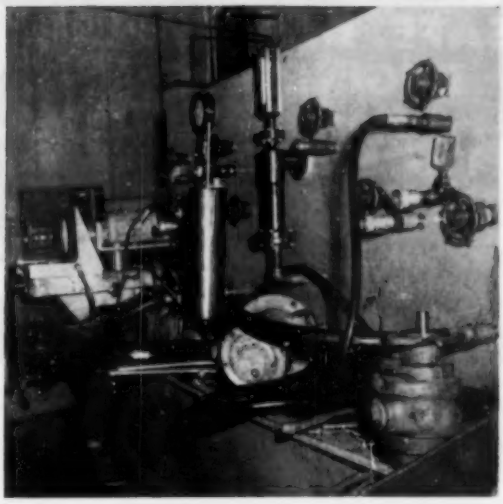
CIRCLE 118 ON READER SERVICE CARD

COMPLETE REPAIR AND OVERHAUL facilities are offered by Galis Electric & Machine Co., Morgantown, W. Va. Every make and type of mining machine is serviced from West Virginia, Virginia, eastern Ohio, Pennsylvania, and eastern Kentucky.



TEST STAND FOR HYDRAULIC COMPONENTS permits complete checking and repair. Set-up at far end is for mounting either a pump or motor on the hydraulic unit shown, which also can be operated as a motor or pump accordingly. Flows of 70 gpm and pressures to 3500 psi are available on the stand.

• **Pump misalignment**—One manufacturer of mining equipment mounts the pump on a gear reducer. Wear in the pump shaft connection caused misalignment and damage to the shaft seal. The pump then begins to draw air resulting in cavitation and pump failure.

Higher pressures requiring piston pumps present a maintenance problem, because very little repair can be done at most operations. Any scoring from foreign material or spring breakage on the port plate, or piston barrel would require precision machinery to maintain the necessary tolerance for repair. Cost of parts for these pumps is also considerable. The piston barrel and port plate can amount to $170, where a gear pump, with greater flow capacity, may be obtained for the same price.

• **Best place for filters**—Our recommendation on suction filters is to get rid of them. Starvation is as bad as dirt. We find that almost an equal amount of pumps fail because of cavitation as foreign material. A high pressure filter is probably the best, but those now available are too small to accommodate the amount of dirt and other foreign material collected over a normal working period. A good filter for installation in the return line is available, but we feel this is the wrong place for filtration of mining equipment because of the back pressure and heat created. On most of our equipment, the reservoir is minimum and hosing has sharp bends because of limited design space.

Much of the dirt enters the reservoir through the breather filling inlet. The use of a small hand pump with a good filter to put oil in the reservoir would eliminate much of the trouble. Another reservoir accessory which would be helpful is a low level oil control. This could be actuated by a float or other method that would give a warning or stop the machine before damaging any component.

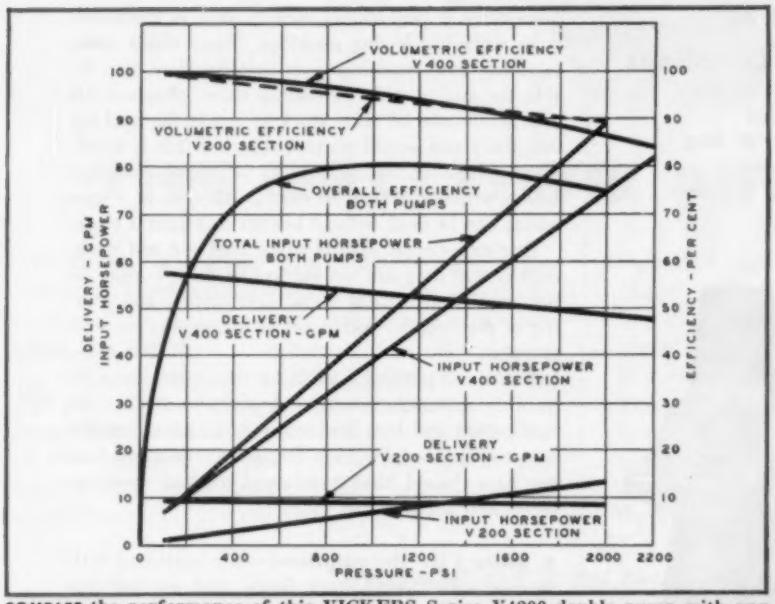
• **Pipe threads most practical**—We realize the advantages of straight-thread fittings to prevent leakage and permit better positioning, but conditions in mines make us think that pipe threads are still the most practical. Leakage is not a primary concern, although there is plenty of it, and part of it is caused by a practice of overtightening all hose connections resulting in pulled threads and crushed pipe. A rule in the mines is to tighten a fitting or bolt—then give three more turns! The reason for our thinking on pipe is its availability and the supply problem. There are always pipe and pipe tools, as well as spare parts at mine service points, because these are used for many purposes.

We also recommend hose assemblies with pressed-on ends. Hose assemblies in sizes larger than ¾-inch are a problem to assemble without proper machines, and these are not practical to use underground. Even when assemblies *can* be fabricated, the repairman with tools available to him cannot prevent cutting small pieces of rubber from the inside of the hose, and this can cause failure in any component. Also we would like to see manufacturers of mining equipment standardize on hose lengths as much as possible. This would cut down on the number of items necessary to transport parts and stock near the mining machine. This is a maintenance problem in itself.

• **Cylinder construction**—Rust and misapplication are our problems here. Because of conditions in the mines, most piston rods should be chrome-plated or metalized. We have also found that stainless steel has definite advantages for some applications. Some piston rods are subjected to material striking the rod and causing scoring. In addition pressure settings above a safe range can cause bending. With the stainless steel rod, we have found that we can grind .060 inch undersize and

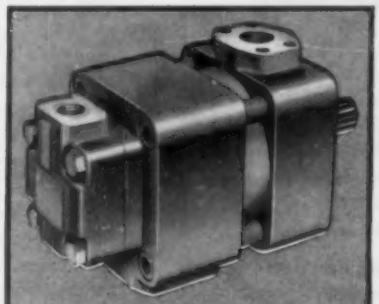
On tractor shovels, scrapers, lift trucks, truck cranes, bulldozers, motor graders, front end loaders, ditchers, trucks, buses and many other types of mobile equipment . . .

The *High Efficiency* of Vickers Balanced Vane Pumps Means *More* Work From *Less* Input Power



COMPARE the performance of this VICKERS Series V4200 double pump with any other hydraulic pump used on mobile equipment. The high overall efficiency in the operating pressure range is maintained throughout the long pump life (see right hand column for reasons). This performance is characteristic of all Vickers Vane Pumps . . . both single and double. (Above curves are in accordance with SAE test code except speed is 2000 rpm.)

Series V400 pump (single) is large section of double pump at right; performance characteristics are shown above. In addition to the advantages mentioned in the right hand column, Vickers Vane Pumps require minimum maintenance and are exceptionally compact. Their various mountings and optional pressure outlet connection positions provide greater application versatility. See pages 4-5, Bulletin M5101A.



Series V4200 double pump for operating two independent hydraulic circuits from one power source. In numerous mobile applications, this is desirable to eliminate all possible chance of one operation interfering with another . . . when necessary to operate two machine components simultaneously at different speeds and hydraulic pressures. See pages 6-7, Bulletin M5101A.

You can get more useful work out of a given engine when a Vickers Balanced Vane Pump is used in the hydraulic control system. Its exceptionally high volumetric and overall efficiency are available not only when the pump is new but also throughout its long life.

The performance curves at the left merit your careful consideration. Note that the overall efficiency is approximately 80% at operating pressures used. Compare this with the rapid decline in overall efficiency of the usual gear pump at higher pressures. This large difference means a very substantial saving in engine horsepower and fuel consumption. To do a given job, it often means that a smaller engine can be used. It further means less heating of the oil.

Vickers Balanced Vane Pumps have many other benefits for the user. Optimum running clearances are automatically maintained over the entire operating pressure range and throughout an exceptionally long pump life. Complete hydraulic balance eliminates pressure-induced bearing loads. Other bonuses are: automatic wear compensation, temperature adaptability, simple installation, and easier cold weather starting.

Millions of Vickers Vane Pumps are in daily use. For further information write for Bulletin M5101A.

7856

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Mobile Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
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R. G. WILLIS . . .

use V-ring packing. Chrome or metalizing on a shaft is not generally .060 inch.

Telescopic cylinders are sometimes misapplied and subjected to side stresses. On one application we redesigned the mounting at one end to give better alignment by changing the clevis mount to a cradle type mechanism giving a universal joint action. The other end of the cylinder had a ball-and-socket connection.

• **Packing installation**—One of the greatest difficulties in performing maintenance in the mines is in replacing V-ring packings. Many times when inserting these packings past threads, they turn inside out and provide no sealing under pressure. Of course, the use of shim stock to guide the packing into the gland would prevent this, but this is usually not available. One possibility is heavier packings which would not turn so easily. Another is a type which can be used without header or follower rings.

Our experience with O-rings used for rod packings is that they are too subject to dirt. V-rings do not require as critical gland dimensions, and scoring of the cylinder rod is not as detrimental as with O-rings.

For small packings, we have little preference regarding material. Selection depends mostly on the application and how frequently it operates. Leather is not very good for high frequency operation, and we have found that reinforced rubber packings work well for this use.

• **More FRF development**—We have had little success with fire-resistant fluids, and we feel that more development is needed before these are practical. Pump and motor life has not been good with these fluids. Make-up for water-base fluids should be available ready-mixed because of the poor water available in the mines. Perhaps tightening up the system plumbing and reducing leakage would help in further use of these fluids, but that is a difficult job with present maintenance standards, and cost is a big drawback at present fluid usage.

• **Temperature control**—Heat generated by hydraulic systems is a problem on mining machines, and we think something should be done either in re-designing components or supplying oil coolers. In many cases, reservoirs are too small—we know of one machine with a 12-gpm pumping capacity and a 7-gal reservoir! Maintenance men are sometimes able to double reservoir capacity for some machines.

We would like to hold temperatures to 120 or 150 F. We've seen equipment operating with the hose too hot to touch. The cheap oil which is frequently used has poor viscosity index, so that operating characteristics change as the machine heats up.

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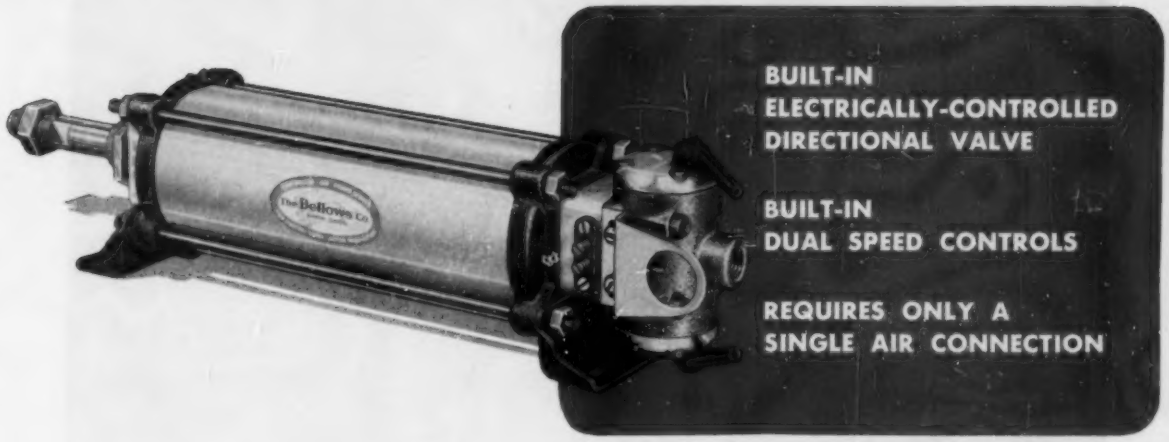

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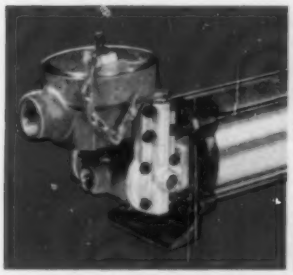

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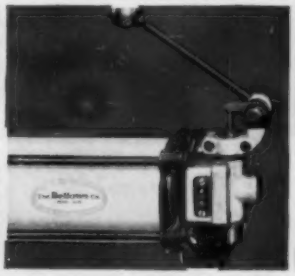

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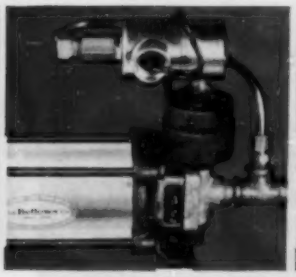

115 V. MAINTAINED CONTACT
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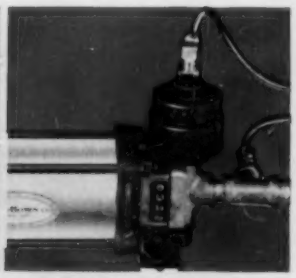

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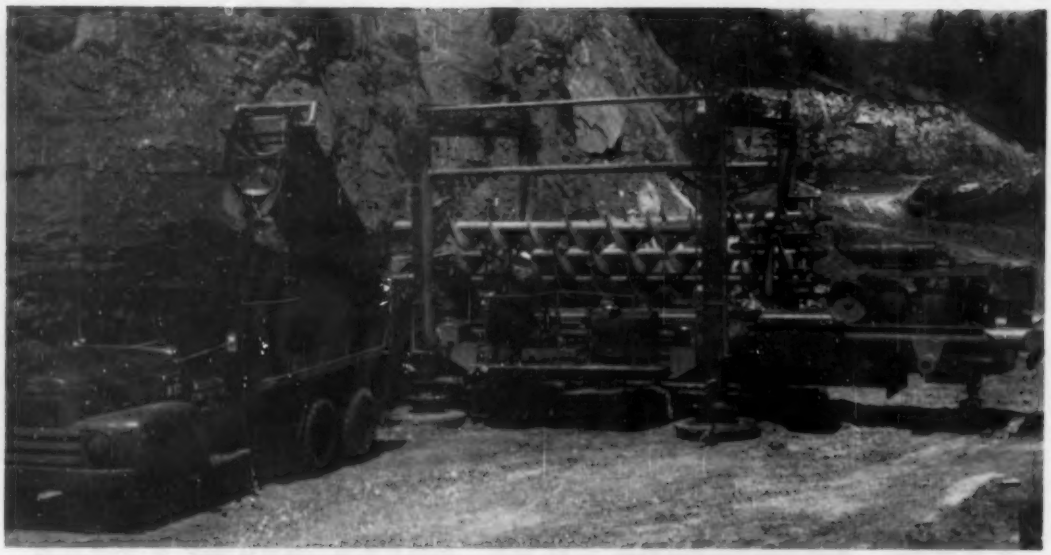


ABOVE-GROUND MINING AUGERS have reservoirs at least twice pump capacity. Screen-type suction filter and oversize pump mean pump life of 2 to 3 years.

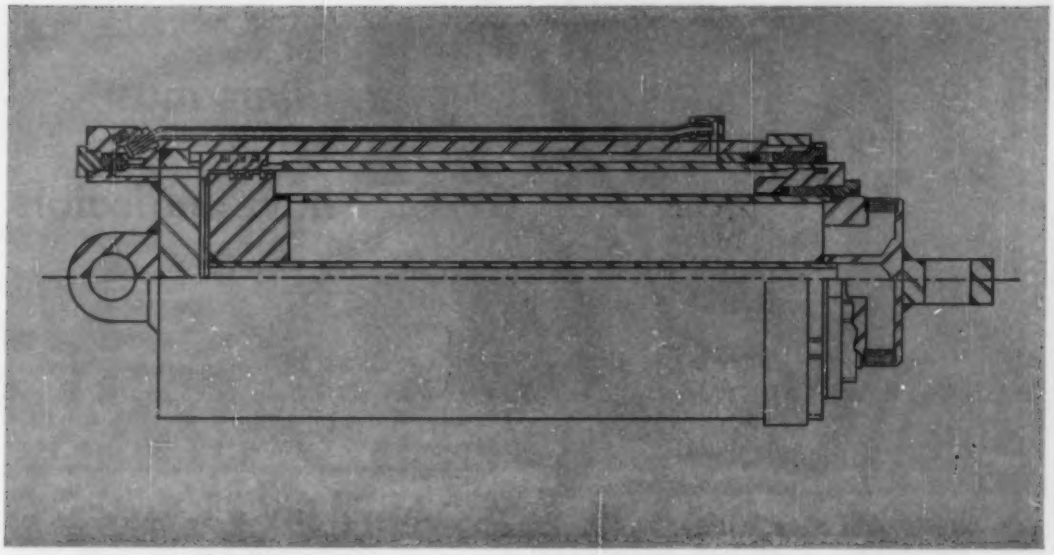
. . . more compact, greater volume pumps at higher speed, pressure.

FRANK DELLI-GATTI
Vice President, Engineering

Compton, Inc.

DON'T SKIMP on reservoir capacity if you want good performance from hydraulic machines. Even though our new miner which employs two fluid motors for cutting 3 to 6 tons of coal a minute is only 27½ inches high, it has a reservoir 1¾ times pump capacity. That gives enough room for a micronic suction filter and means better heat dissipation. On above-ground mining equipment, reservoirs are sized at least two times pump capacity, and pumps are selected with 25 or 30% greater capacity than needed. This liberal design shows up in increased pump life.

• **Higher pump speeds**—We're getting up to 2 and 3 years life from vane and piston pumps,



TELESCOPIC CYLINDER has relief valve to prevent drifting under load because of leakage. Putting both ports at one end eliminates hose movement.

which we prefer because of their high efficiency. As mining becomes more marginal and coal seams get smaller, mining machines must follow along. Higher speeds for electric motors and pumps is going to have to be part of the answer to getting more horsepower in a smaller package. Electric motors are now rated for 1750 rpm. Pumps should be designed for at least this speed. We have increased pump output from 29 to 45 gpm by running the pump faster than rated, but in some cases we have also gone to belt drives to drive the pump at its rated speed. Belt drives mean more space and cost, so we avoid them if possible.

• **5000-psi future**—Higher pressures are, of course, the rest of the answer to more compact machines. We're looking forward to using the 2500-psi vane pump and will go to even higher pressures when components are available. The piston motors we are now using are as small as necessary for our purpose, but a vane motor could be less expensive. Hose is a problem at higher pressures. We've had trouble with reusable hose fittings blowing off at 2800 psi. At 5000 psi we'll probably have to go completely to rigid piping and swivel joints because of inflexibility of hose to withstand this pressure. We're using these in some applications now.

We would like to see more compact, manually operated, directional control valves with smaller handles. Because of the bulkiness of presently available valves, we are using small pilot valves which in turn actuate the main directional controls.

• **Licked leakage**—One problem we've solved by a special design is leakage in our telescopic cylinders. This leakage was allowing the cylinders to drift down under load. This has been corrected by a telescopic cylinder designed with Commercial Shearing & Stamping Co. and incorporating a check valve in the cylinder as shown in the figure. Leakage past the rings of the secondary cylinder is connected back through the tube to the check valve which is set for 9000 to 1000 psi. When pressure is removed from the cylinder for lowering, the check valve opens connecting leakage fluid back to the inlet side of the cylinder.

. . . . Our biggest problem is the time required in preforming steel tubing. Also we have the problem of storing this pre-formed tubing. If we could get Nylon tubing in sizes larger than the 3/8-inch maximum OD presently available, we could cut our installation time by 75%. Our circuits operate at about 800 psi; so the 2500-psi burst pressure of this tubing would be sufficient.

ROBERT A. REDDING, Jaeger Machine Co.

JOSEPH J. SLOMER
Hydraulic Engineer

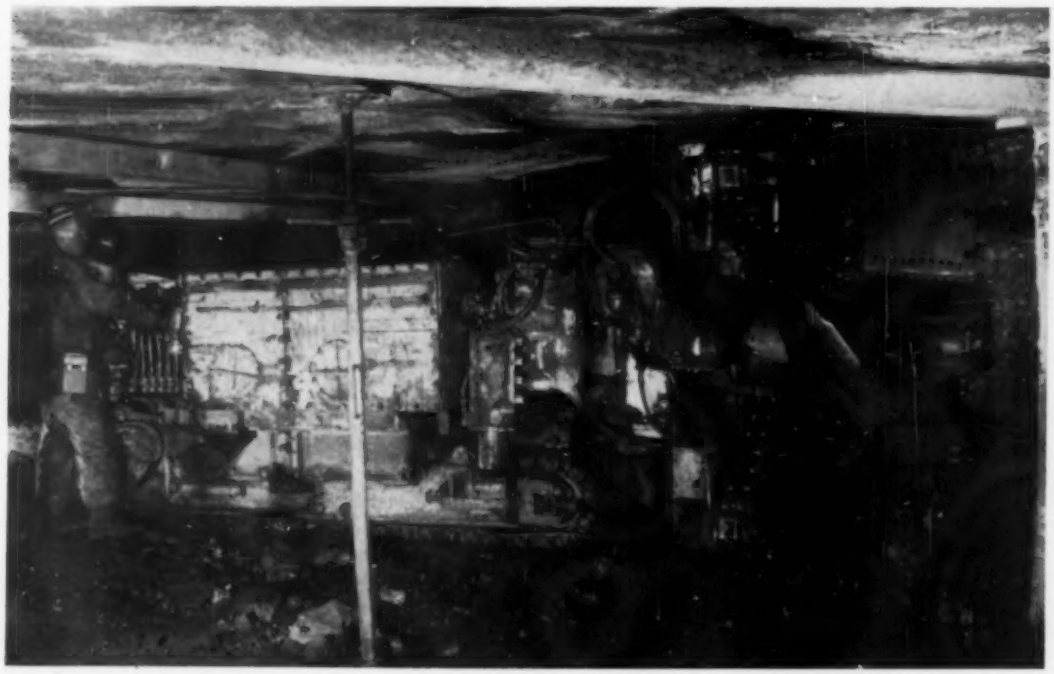
Goodman Manufacturing Co.

. . . filters must have indicators

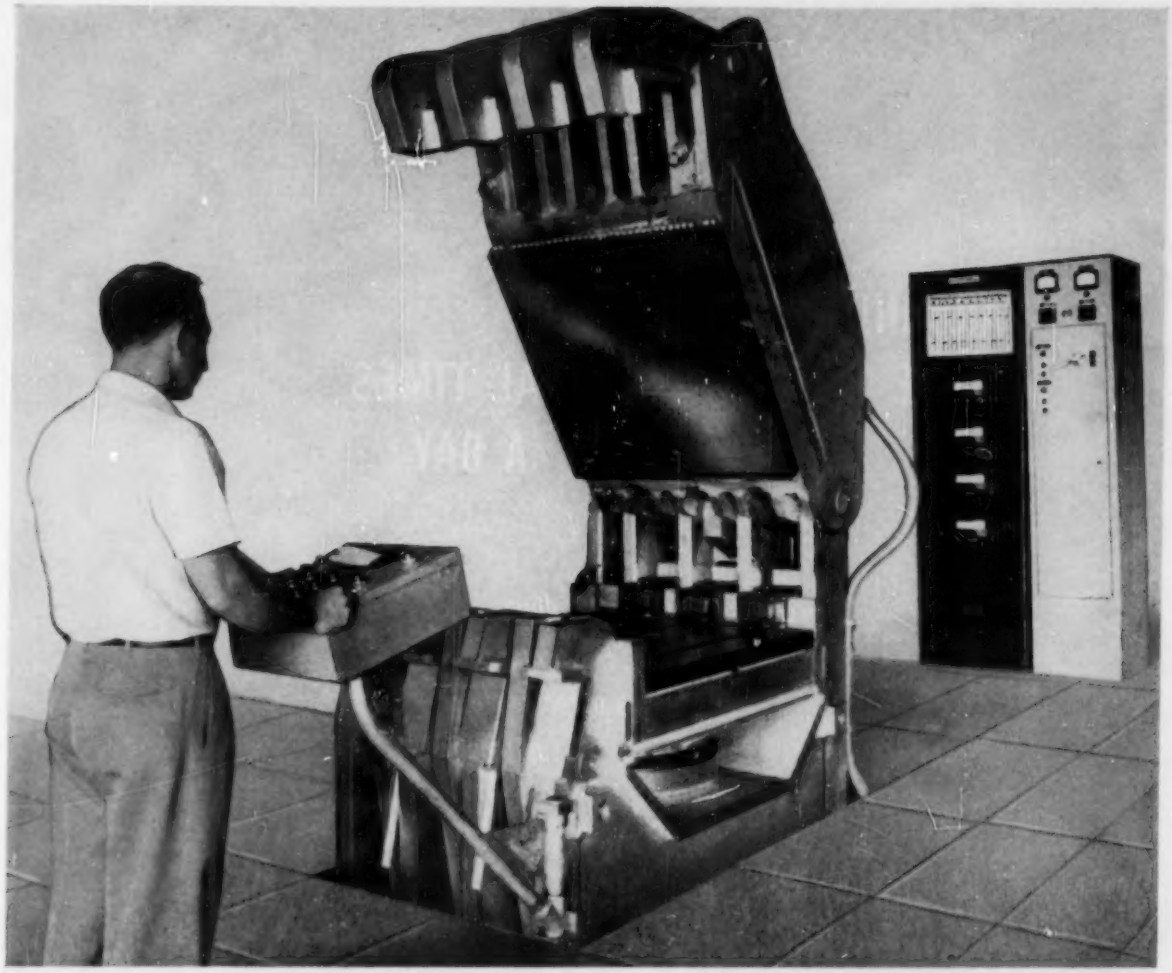
ONE OF the biggest factors in successful operation of our mining machines is effective filtering. We are using a 6-8 micron filter on the pressure side of the relief valve. Even finer filtration has been considered, but this would require going to a micronic filter such as the cellulose type. Because of space limitations this is not feasible in our present designs. We are using an indicator on the filter to indicate when it must be replaced, and have worked with a manufacturer of a new filter unit which has a built-in bypass and orifice for partial filtration.

We do not like the venturi-type filter because it is impossible to tell when the unit is working properly. Also we prefer a screen-type filter to the edge-type. Although the latter may be easier to clean, the larger area of the screen type is an advantage, especially in circuits where large flows would require a large, edge type filter.

We are doing some testing of spiral wrap hose rated at 20,000-psi burst pressure. This spiral wrap is more flexible than 4-wire braid hose. ▼▼▼



CONTINUOUS MINER has a variable delivery pump. Re-designing the pump control piston with an O-ring seal has increased efficiency of hydraulic system.



Automatic press by T. W. & C. B. Sheridan Company virtually ends all hand work in straightening and finish-forming titanium and stainless steel parts. A push-button hydraulic system powers side-pressure cylinders with up to 75 tons of muscle and drives the vertical ram at pressures up to 300 tons.

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Take a tip from leading manufacturers of hydraulic equipment . . . eliminate flammable hydraulic fluid wherever it so much as hints at being a fire hazard. A small investment in Pydraul now can repay you many times over in protection *and* performance. Your Monsanto representative will be glad to demonstrate the firesafety of Pydraul versus your present fluid, to calculate the low cost of conversion and to help you make the change.

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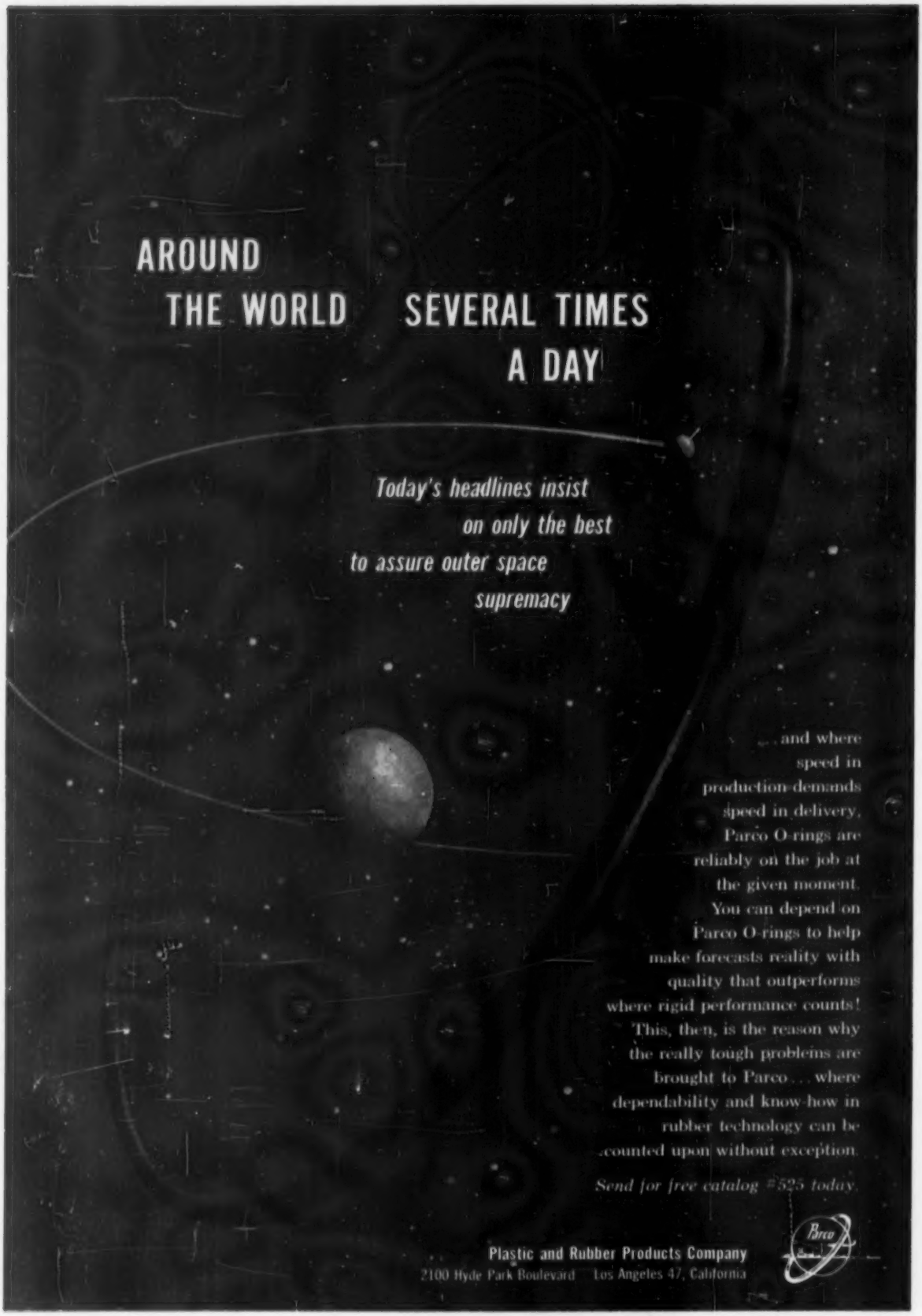
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AVIATION SECTION

Applied Hydraulics

DECEMBER 1957

CYLINDER MATERIAL
. . . steel or aluminum 111

By P. Person

Weight, strength, high-temperature resistance, fatique life as well as application must all be considered when choosing an aircraft cylinder material. Relative merits of the two most-commonly used materials are discussed.

FLUID POWER AT FARNBOROUGH 117

By John A. Lankester, A. R. Ae. S., European Editor

A report on interesting new hydraulic and pneumatic components and systems displayed at Britain's Society of British Aircraft Constructors' Annual Exhibition and Flying Display in September.

PNEUMATIC DIAPHRAGM VALVES
. . . control cooling air temperature 120

By Clinton G. Miller

Poppet and gate-type, pneumatically operated valves control cooling air temperature within close limits on the Convair B-58 Hustler.

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AVIATION COMPONENT DATA 126

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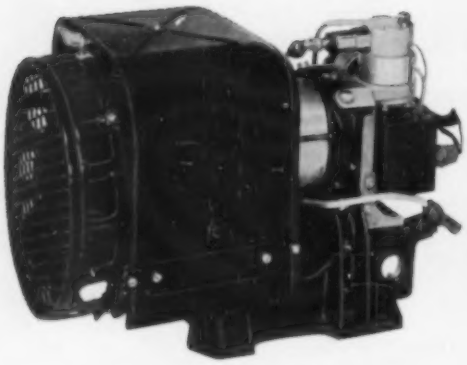

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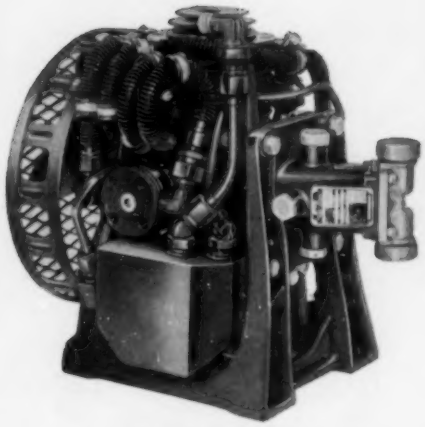

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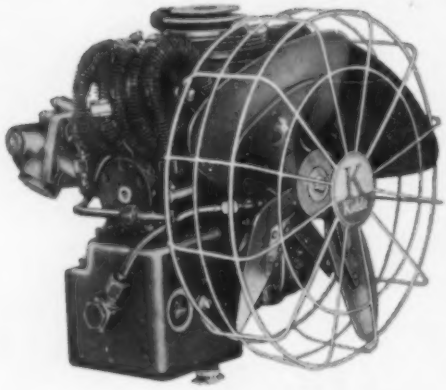

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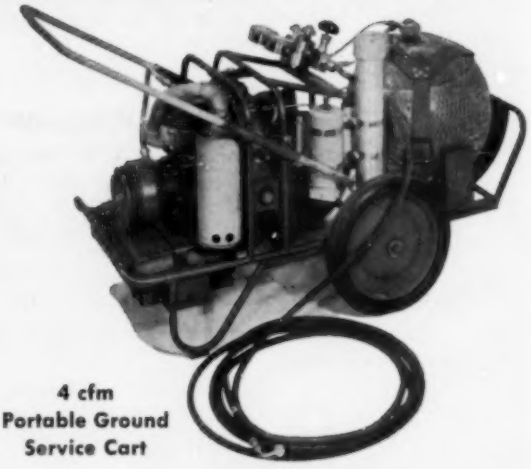

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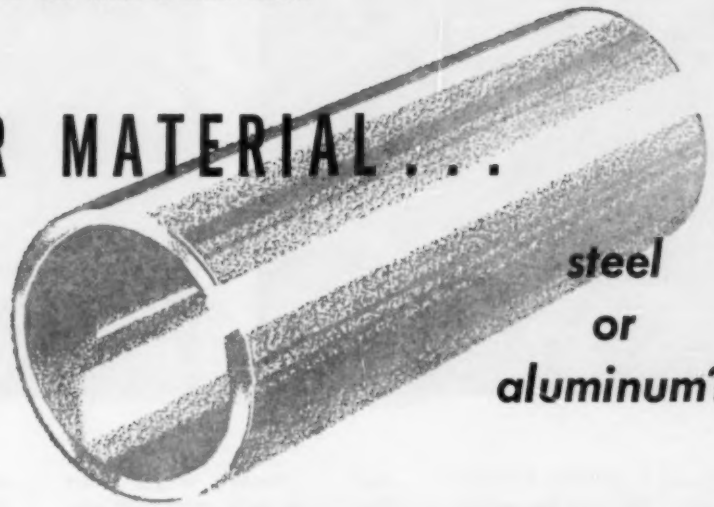
Should steel or some aluminum alloy be used for aircraft hydraulic cylinders? There is no standard answer to fit all cases. Operating conditions vary with application. Each application must be analyzed to select the proper material. This discussion will help the designer to reach a clear-cut decision for one material or the other in most cases.

CYLINDER MATERIAL . . . steel or aluminum?



• By. P. Person

Senior Hydraulic Designer,
J. E. Shay Ltd.,
Basingstroke, England

SINCE structural failure of a hydraulic cylinder on an aircraft can have such serious consequences, importance of adequate tensile and fatigue strength cannot be overemphasized. Recognizing this and the fact that aluminum alloys are probably not the best material for repetitive loading which leads to fatigue failure, designers may tend to use steel with no further consideration of the factors involved. However, extremely valuable weight reductions can be sacrificed by this approach to cylinder material selection. A thorough analysis should be made before a decision is reached.

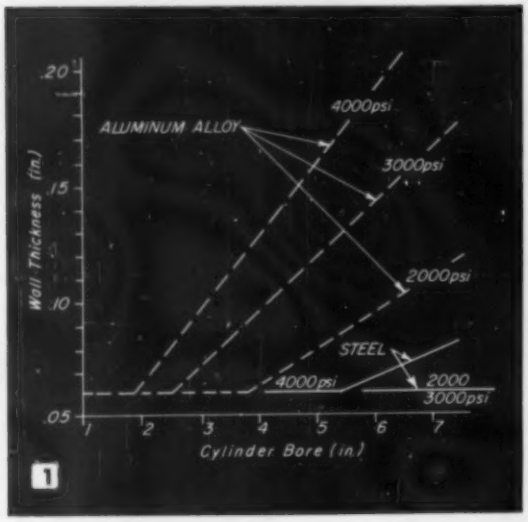
• **Strength**—Strength at the maximum computed pressure and fatigue life must be considered when selecting material for a cylinder. For comparison purposes, the properties in Table I for steel and aluminum alloys will be used. These are representative values. The value for aluminum alloy was chosen to allow for the reduction in strength of aluminum alloys when stresses are applied cross grain, since hoop tension—a cross-grain stress—is the usual criterion for cylinder strength.

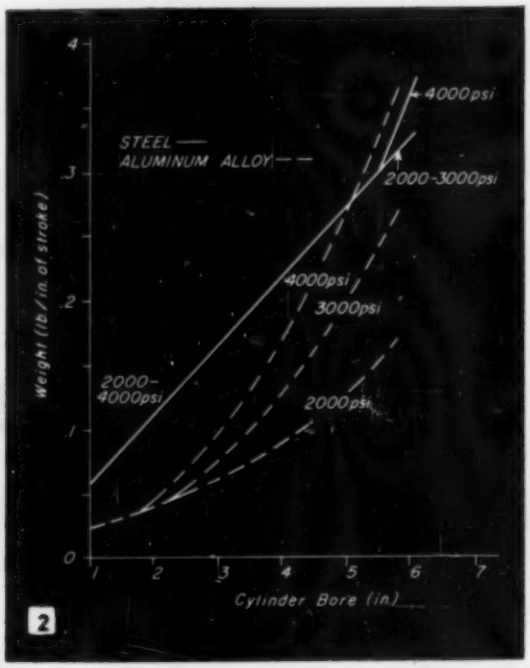
Critical or maximum required strength depends not only on cylinder loading but also whether internal or external stops are used. For this analysis, it will be assumed that internal stops are used, and that full load pressure is applied throughout the stroke in both directions. Maximum stresses are:

1. Hoop tension at maximum fluid pressure.
2. Hoop tension combined with compressive bending stress in the end cap to give maximum shear stress.
3. Tension load due to maximum pressure on the full piston and end area when the rod is fully extended.
4. Tension load due to maximum pressure on the annular area with the piston in an intermediate position.

TABLE I—Properties of Steel and Aluminum Alloys

Material	Ultimate Strength (psi)	Density (lb/cu in.)	Strength-to-Weight Ratio
Steel	160,000	0.283	283
Aluminum alloy	56,000	0.102	274





Cases 1 and 2 normally determine thickness of the cylinder and hydraulic connection bosses. Case 3 determines required strength in tension of the open end undercut and the length of threads required for the end cap. Case 4 determines strength of the mounting lugs or bosses.

Wall thicknesses of cylinders for pressures of 2000, 3000 and 4000 psi for a range of bores as calculated by the thin cylinder formula using a safety factor of 2.0 are shown in Figure 1. Lower limit of 0.06 in. for wall thickness is imposed by machining problems and seal efficiency. Limit imposed by elastic swelling of the cylinder under pressure sufficient to make the seals ineffective is quite arbitrary and is not considered. Although strength-to-weight ratios of steel and aluminum are nearly equal, Figure 2 shows that for the wall thicknesses of Figure 1, aluminum results in a much lighter cylinder over a range of bore sizes.

Weight differences resulting from material differences in other parts of the cylinder such as lugs and bosses cannot be analyzed quite so precisely. However, when lug profiles are dictated by the need for blending shapes rather than by strength, more than adequate strength will probably be provided by aluminum, and the weight will be less.

Another factor which usually works in favor of aluminum is that in many cases lug width or trunnion pin size is dictated by bearing pressures rather than the strength of the lugs or pins. Again, these members will probably be of more than adequate strength and will weigh less in aluminum.

• **Fatigue Strength**—Total number of pressure pulsations to which a cylinder will be subjected and their magnitude depends upon pump characteristics, hydraulic circuit design, frequency of use of the particular cylinder, and design life of the airplane. Estimation of the total number of pressure impulses to which a cylinder will be subjected and their magnitude requires a good deal of experience and a crystal ball might be quite helpful. Nevertheless, these things can be determined with sufficient accuracy to determine whether steel or aluminum should be used.

There has been much discussion on the preferred method for converting an actual operating pressure cycle composed of a number of pulsations at different pressure levels into a number of pulses at one fixed pressure level to make fatigue strength testing practical. It is assumed here that a satisfactory method for doing this has been selected, and that the operating cycle and life have been converted into a number of pulsations from zero to maximum pressure and back to zero again. Required number of pulsations which the cylinder should be able to withstand on test must include a safety factor which reflects the degree of damage which would result from cylinder failure. A factor of 2 might well be specified if failure endangered the aircraft.

Since fatigue life of a cylinder depends upon material quality, surface finish, protective treatment, presence of stress raisers, material elongation properties, and small design details, the only way to use the predicted life requirement is for the designer to assemble data based upon actual test of cylinders representative of those he will be using. A large amount of data on test specimen bars is available. However, there does not seem to be any particularly valid correlation between

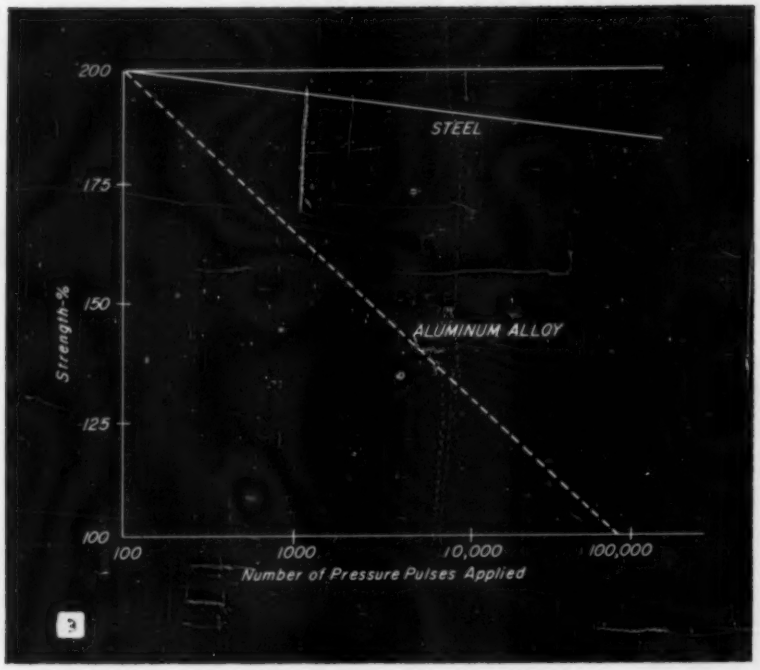


FIG. 1. WALL THICKNESS REQUIREMENT in steel and aluminum.

FIG. 2. WEIGHTS of aluminum and steel cylinders.

FIG. 3. FATIGUE PROPERTIES of steel and aluminum alloy cylinders. Pulses are test pulses from zero to maximum pressure and back to zero. Strength is based on an initial value sufficient to withstand a load equal to four times the test pressure.

these test results and the complex loading conditions existing in a hydraulic cylinder. Stress distribution at the end cap thread undercut, for example, is quite complex and only actual test of representative cylinders can provide the required knowledge.

With sufficient test information available, the designer can correlate design stress levels with repetitive loading in a form such as that shown in Figure 3. It must be emphasized here that the values in Figure 3 are purely representative and should not be used quantitatively in design.

Assuming that the data in Figure 3 were accurate, it is apparent that aluminum is a very satisfactory cylinder material, provided the fatigue strength requirement is not higher than 10,000 pressure cycles. Steel will certainly provide a lighter cylinder when fatigue requirement is 100,000 cycles or more. Note that these pressure cycles are not the number of actual operating cycles in the airplane. Between the 10,000 and 100,000 pulse requirements is a band which probably covers the majority of cylinder applications. Here each application must be analyzed to arrive at the proper material.

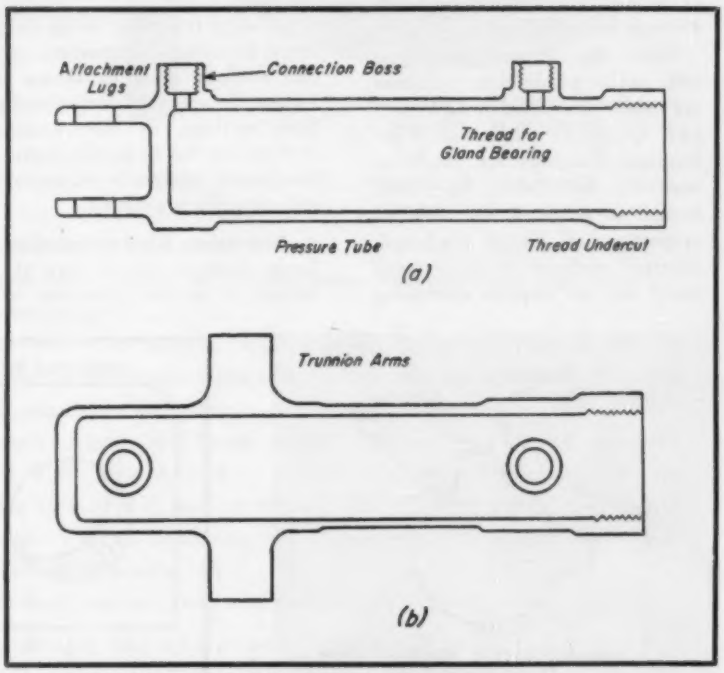


FIG. 4. TYPICAL CYLINDER body elements.

• **Cylinder Construction**—Because the method used in producing a cylinder affects cost as well as strength, types of construction considered in this analysis will be described. Certain precautions in specifying material for cylinder construction will also be covered.

Generally, cylinders for aircraft service are designed for attachment to the aircraft in one of two ways. First method uses single or double lugs at the blind end of the cylinder for a pinned connection, Figure 4a. Second method uses two bosses or pins extending from the cylinder wall for a trunnion-type mounting, Figure 4b. Cylinder bodies are closed at one end and threaded at the other for the gland bearing. Bosses are provided for the necessary hydraulic port connections. Current practice is to use 160,000 to 180,000-psi tensile strength steel or 64,000 to 70,000-psi tensile strength aluminum alloy.

When steel is used, prototype and early production cylinders are usually machined from a solid bar. Quantity production uses forgings. Forgings are produced near the final size; then heat treated to achieve the required properties and finish machined. External surfaces of the forging which do not require machining may be polished to eliminate stress-raising imperfections if fatigue requirements are high.

Aluminum alloy cylinders are usually made from extruded round bar for prototypes and small production quantities. Quantity production may be from extruded round bar or forgings. Both extrusions and forgings are normally rough machined, heat treated and then finish machined. When forgings are used, particular care must be taken to see that material in the vicinity of the flash plane is removed since it has extremely low elongation properties and a grain direction leading to low fatigue strength and high susceptibility to stress corrosion. These effects can be nullified by a second forging process using another die which removes core material and nullifies the previous flash-plane effects. However, such forgings are rather costly.

Although round bar is the usual shape for cylinder extrusions, special sections, such as shown in Figure 5, are used occasionally. Such sections, by incorporating sections for the hydraulic connection bosses, economize on material and simplify machining.

• **Extrusion Characteristics**—Large diameter round bars of 4 inches or larger diameter are normally extruded through a single-hole die, Figure 6. Such bars have a peripheral ring of coarse-grained material which has slightly lower strength and higher elongation than the fine-grained interior. This coarse-grained material must be eliminated by a preliminary machining operation to a depth of about 10% of the diameter.

For round bars of smaller diameters, 4 inches or less, a multi-hole extrusion die is often used. With a multi-hole die, three, four or more bars are extruded simultaneously. The coarse-grain region in this instance has a more indeterminate form, Figure 6. Therefore, it becomes impractical to machine it away to leave only the fine-grained portion. Therefore when cylinders are to be machined from extrusions, single-hole extrusion should be specified.

• **Temperature Considerations**— High temperatures, above about 400F usually eliminate the possibility of using aluminum as a cylinder material. Above 400F, usual aluminum alloys lose their properties and are no longer economic structurally. Therefore, steel should be used for cylinders to operate above this temperature. A recently developed wrought sintered aluminum may prove to be useful at these temperatures if the cylinder will not be too highly stressed. ▼▼▼

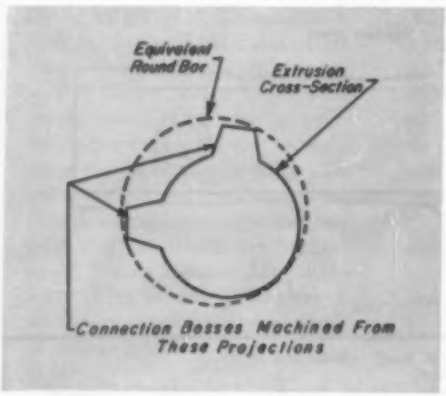


FIG. 5. SPECIAL EXTRUSIONS incorporating sections for the bosses can reduce cylinder machining time and save material.

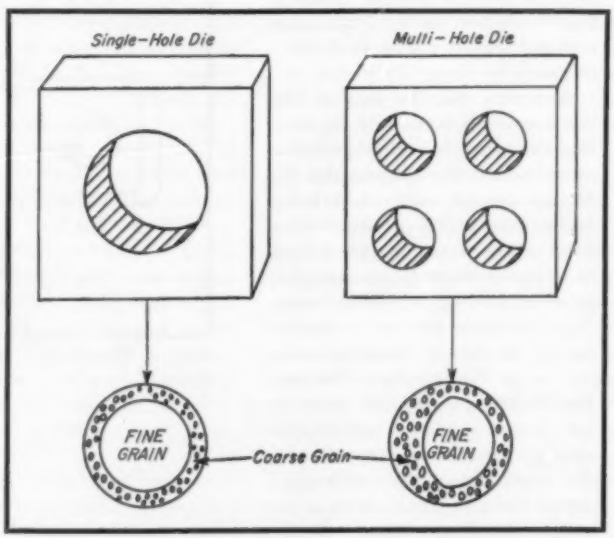


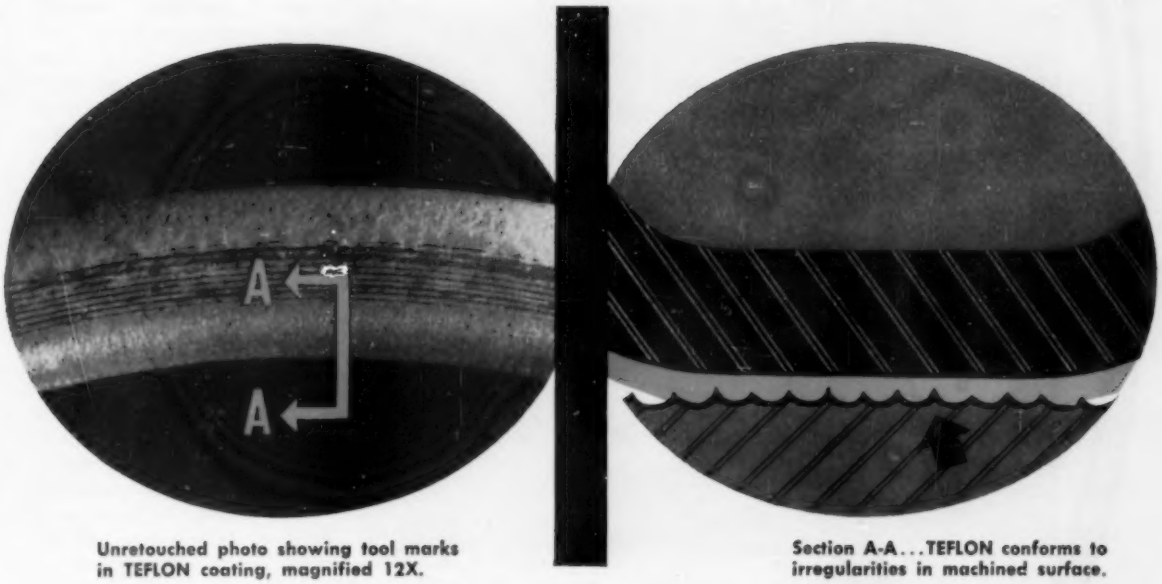
FIG. 6. CHARACTERISTICS of extruded round bars.

Magnified 12X reveals why Teflon* coated

UNITED METALLIC O-RINGS...

are the *perfect seals* for

LIQUID NITROGEN • LIQUID OXYGEN • AIR • FUELS



Unretouched photo showing tool marks in TEFLON coating, magnified 12X.

Section A-A...TEFLON conforms to irregularities in machined surface.

The 12X magnification proves that *Teflon*, permanently bonded to a United Metallic O-Ring, conforms to normal tool marks which it contacts in a machined seat. These microscopic valleys and ridges are exactly reproduced in reverse on the *Teflon* coating, as shown in photograph. This remarkable, non-porous, pliable coating compresses into these irregularities to help form a perfect seal.

United Metallic O-Rings, when *Teflon* coated, retain the spring steel characteristics of the metal, and provide the added advantage of the surface conformability of a rubber-like compound. Finish is completely non-corrosive and resistant to chemical action.

Extensive tests involving gases and liquids, at both high and low pressures, prove the absolute sealing action of *Teflon* bonded to stainless steel type 321 O-Rings. Tests included liquid nitrogen to —321° F. and hot air to +600° F. *Teflon* coated O-Rings are recommended for simple V-clamp installations, where they reduce the amount of compression-load required to make a positive seal.

United Metallic O-Rings may be made to practically any required dimensions.

Write for complete information.

*Teflon is the registered trademark for DuPont tetrafluoroethylene resins.

UNITED METALLIC "O" RING CORP.

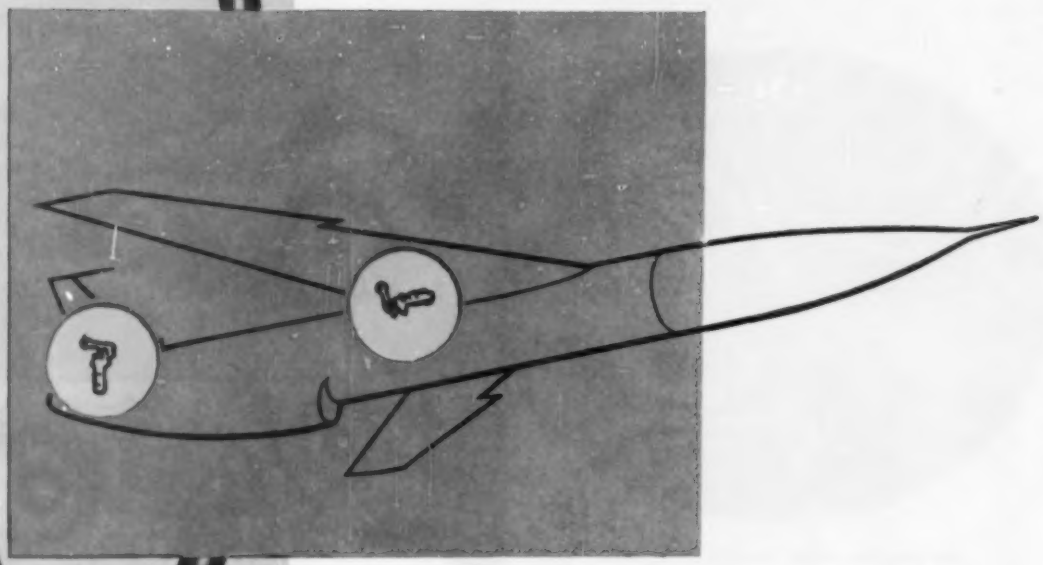
Dayton, Ohio • Box 1035

Division of United Aircraft Products, Inc.

CIRCLE 109 ON READER SERVICE CARD

. . . To blast an INVADER . . . .

LINEAR KEEPS THE "GO" IN PROTECTIVE MISSILES with Jet-Age "O" Rings



Modern warfare weapons . . . that guard and protect . . . are highly complex devices. They must be dependable for instantaneous service—even after an unpredictable shelf-life.

In rocket and missile warfare use, "O" rings will be subjected to nitrogen, JP-4, ethylene oxide, hydrogen-peroxide, alcohol, liquid oxygen, fuming nitric acid, and other destructive environments. "O" rings are used in the servo-systems for flight control of guided missiles, and must withstand extremes in temperatures and the destructive actions of synthetic fluids.

LINEAR's experience in the design and production of precision "O" rings —of the most modern elastomers—has given them the ability to provide dependable seals for the most critical requirements.

When it's a sealing problem, call on LINEAR or one of its agents for engineering assistance . . .

and be sure to specify LINEAR "O" Rings for prototype or production.

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LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

FLUID POWER AT FARNBOROUGH

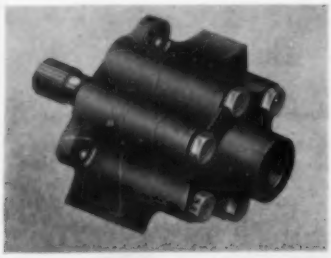
• By John A. Lankester, A. R. Ae. S.
European Editor

THE FIRST week of September was the Society of British Aircraft Constructors' Annual Exhibition and Flying Display at Farnborough, England. This year's show attracted visitors from many countries to see the latest jet and rocket-powered aircraft perform and to inspect a wide variety of components and accessories. For the first time, security regulations permitted exhibition of new missile control components and systems.

Among the latest items of hardware in the guided missile field displayed at the Farnborough Show was a turbine-powered hydraulic power pack developed by the Plessey Co. Intended for use in missiles and test vehicles for recharging accumulators, the pack consists of an isopropyl-nitrate-fuelled turbine driving a pump through a reduction gear box. Combustion of the turbine fuel is started by a small, electrically-fired explosive charge. Fuel input to the turbine is varied in proportion to the load on the pump. Maximum output is 20 hydraulic hp at maximum pressure of 4500 psi. The pack weighs 16 lb. dry.

A new group of missile hydraulic components was displayed by Dowty Equipment Ltd. The group includes: (1) A ten-cylinder axial-piston hydraulic motor with 6-hp. output at 4000 rpm with 3.4 gpm at 4000 psi; weight of the motor is 3.5 lb. (2) A fixed-displacement pump which delivers 55 cu. in. per sec. at 8000 rpm and 3000 psi; minimum life is 30 hr. at 150 C; weight is 7.5 lb. (3) A miniature fixed-displacement pump delivering 2 cu. in. per sec. at 24,000 rpm and 3000 psi; length is less than 2 in.; weight is 12.8 oz. (4) A single-stage servo valve weighing 1.88 lb. to handle 9 cu. in. per sec. at 2000 psi drop; maximum operating pressure is 4000 psi; frequency response is better than 100 cps. (5) A two-stage servo valve with similar characteristics; output to 45 cu. in. per sec.; weight is 4.43 lb. (6) A constant-pressure reservoir which uses circuit pressure on a small piston to load a large piston and thus maintain constant pressure without the need for gas or air inflation; both high and low pressure tanks are available weighing 10.6 and 7.09 lb. respectively.

Ten-cylinder, axial-piston hydraulic motor

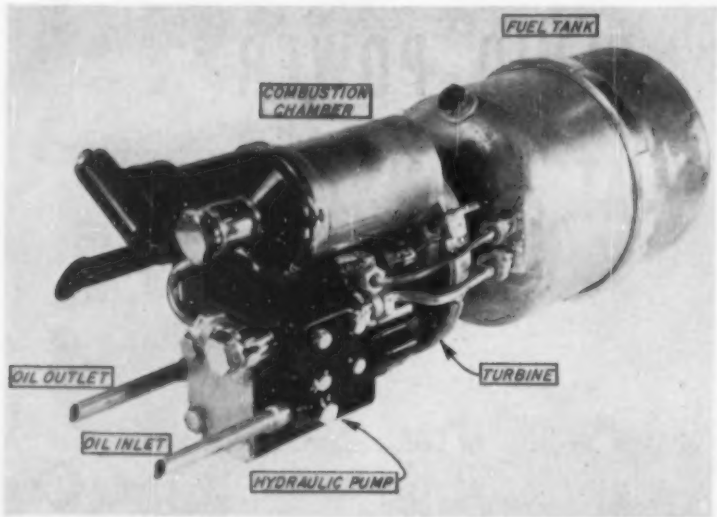


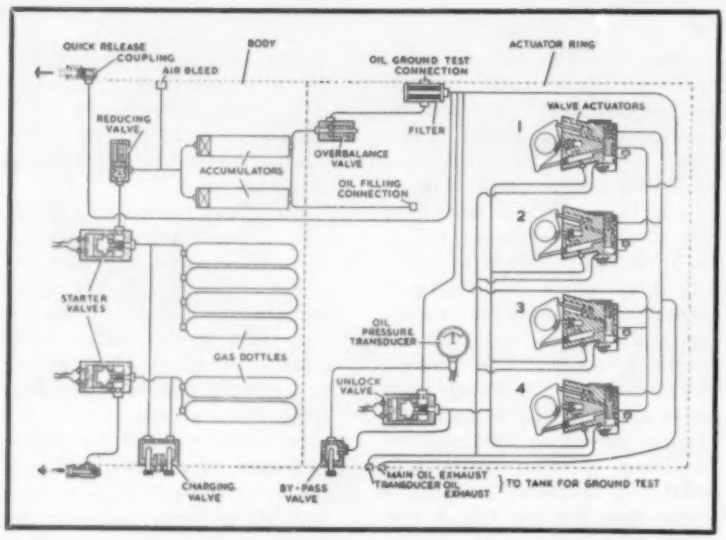
Dowty 24,000-rpm miniature pump

British Messier Ltd. exhibited a complete servo control system for guided weapon test vehicles. A pneumatically energized hydraulic circuit is used. High-pressure gas from four bottles forces fluid through the system. The other bottles shown in the diagram serve another purpose.

The system is used for fin control. A starter valve releases gas to two accumulators, which are completely filled with oil before the system is started. In this system, an unlocking valve feeds pressure oil to unlocking pistons to withdraw the valve actuator locks. An autopilot controls the valve actuators which are electro-hydraulic servo valves and dual piston actuators built as a single unit. All necessary provisions for gas and oil charging as well as ground tests are included in the system. Feedback is provided by inductance pickoffs on the control fins which feed into the autopilot amplifier.

Flight control systems consisting of all the units necessary to convert a small electronic signal into hydraulic cylinder movement were shown by Fairey Aviation Co. Ltd. Valves used are flat-faced, balanced-delivery, slide types developed specifically for this application. Operating load

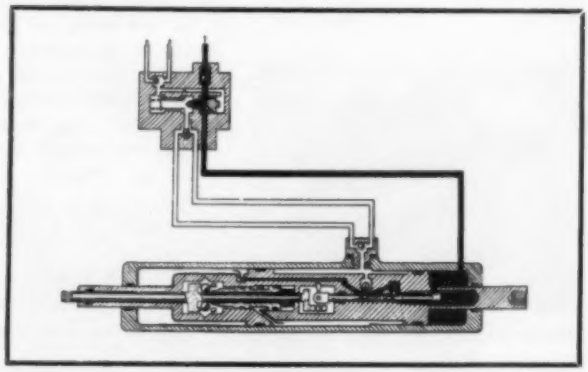




ISOPROPYL NITRATE-FUELLED TURBINE drives hydraulic pump for recharging missile accumulators.

PNEUMATICALLY-ENERGIZED hydraulic circuit for guided missile test vehicles.

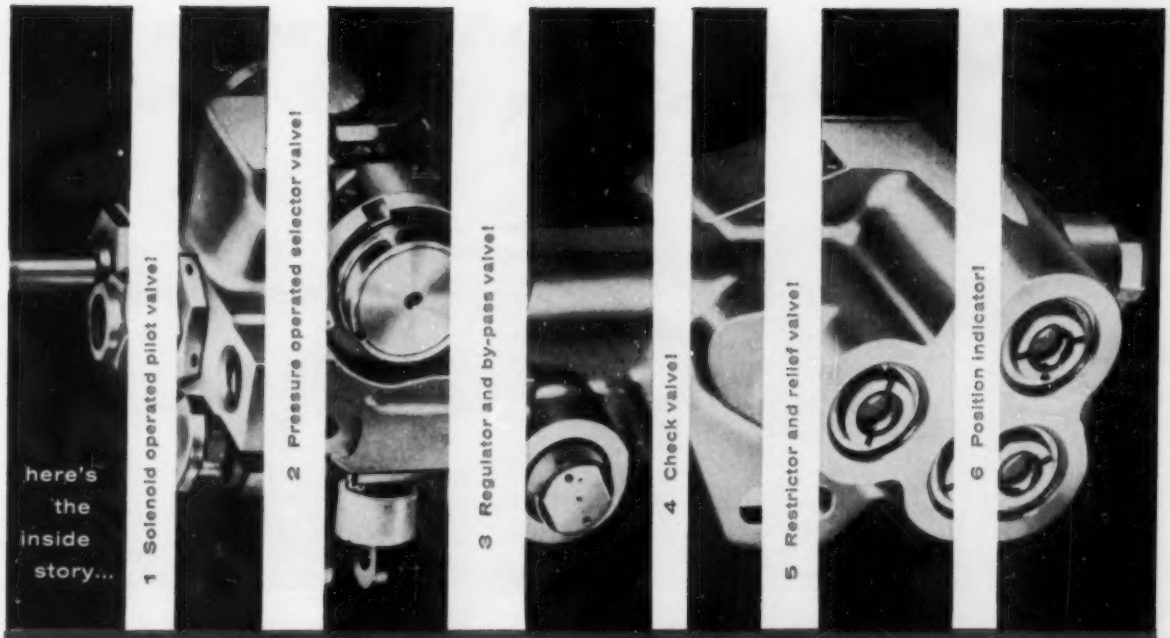
TURNER-LEDUC FLYING CONTROL was shown in Britain for the first time recently at Farnborough.



of these valves is virtually zero under threshold conditions. Units capable of handling 30 gpm at 4000 psi are in production. For flow rates up to 3 gpm, a single-stage valve is used. For higher flow rates, two stages are employed.

Another new flying control system, of French design, was shown in Britain for the first time. It is being produced in the United Kingdom by the Turner Mfg. Co. under license and is known as the Turner-Leduc Flying Control. Features of this unit are: ball valves for fluid control, integral hydraulic damper units, small diameter to fit thin wing surfaces, elimination of the necessity for ground parking locks, dual supply lines, reversion to manual control in case of hydraulic failure or a triple supply line system for applications where no manual control is possible in the event of failure.

Servo unit consists of a double-rod cylinder with unequal area pistons. Area of one piston is double that of the other. Control rod from the pilot's wheel or stick connects to one rod. Other rod is the output member. Ball valves inside the piston are opened or closed by tapered portions of the axially-moving input rod. The piston contains a ball lock which is operated by a spring-loaded, tapered sleeve. The lock is released by pressure of the hydraulic fluid. In the event pressure fails, the spring locks the control rod to the actuating rod and a bypass valve opens. This allows strictly manual operation of the system. ▼▼▼


here's the inside story...
1 Solenoid operated pilot valve!
2 Pressure operated selector valve!
3 Regulator and by-pass valve!
4 Check valve!
5 Restrictor and relief valve!
6 Position indicator!

the new dimension in component packaging!

Weston's Pneumatic Actuator Control Valve Package Combines 6 Components in a Single 6.4 lb. Unit!

While controlling the pneumatic actuator, this weight and space saving valve also provides for snubbing pressure at the opposite end of the stroke. It affords extremely fast operation (maximum at .04 seconds) and low leakage (10 cubic inches per hour). The selector valve is non-interflow and detented to maintain position. If you have a weight and space problem, let Weston's team of specialized package engineers solve your specific application.

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CIRCLE 122 ON READER SERVICE CARD

Temperature control is a problem on modern aircraft such as Convair's B-58 Hustler. Higher speeds and more equipment packed into a smaller space produce heat which must be controlled if the equipment and aircraft are to continue to do their jobs.

PNEUMATIC DIAPHRAGM VALVES

. . . control cooling air temperature

• By Clinton G. Miller

Project Engineer, Air Group,
Parker Aircraft Co.
Los Angeles, Calif.

RELATIVE simplicity and low weight characterize a pneumatic-mechanical system used to maintain correct equipment temperatures in Convair's B-58 Hustler. This system designed and developed by Parker Aircraft Co. uses a high thermal-expansion material and pneumatically-operated diaphragm valves to control mixing of hot and cold air in correct proportions for maintaining a constant temperature. Neither the use of high thermal-expansion materials for temperature sensing or diaphragm-operated flow control valves are new. But these elements have not been used before in this way.

• **Electronic Compartment Cooling Circuit**—for cooling electronic equipment in the Hustler, the system shown in Figure 1 is used. Elements are: a flow control valve, a temperature-sensing valve which controls the flow control valve, a pressure regulator to control air pressure to the system, and the required connecting hose and piping. Function of the system is to meter hot air into a cold air duct to maintain temperature in the cold air duct above a predetermined level. Hot air is supplied by jet engine bleed at pressures of 10 to 250 psig at temperatures of 70 to 600 F. Cold air comes from an expansion turbine at 0 to 10 psig

The skies are full of J-M Clipper Seals

Protecting bearings in many types of aviation mechanisms

Johns-Manville's precision-moulded Clipper Oil Seals retain lubricant and exclude dirt. These seals have a dense asbestos-compound heel and a soft flexible lip concentrically moulded into one unit. This unique construction provides maximum sealability, low torque, easy installation, long life and wide adaptability. Some of their applications include:

In Actuators—In the worm gear drive of hydraulic actuators, Clipper Seals prevent oil leakage at shaft speeds of 0 to 9000 RPM, pressures of 0 to 20 psi and temperatures of –60 F to 250 F . . . with a maximum seal drag of 4 oz. Sketch shows seals used in tandem with specially developed metal adapter ring. Here, Clipper Seals replaced a far more costly seal, maintained high performance.

In Constant Speed Propellers—Used on the blade retaining nut of constant speed propellers, J-M Clipper Seals maintain a tight seal against the 400 psi pressure created by the propeller's velocity. Clipper Seals' light shaft drag permits rapid pitch changes.

Clipper Seals have also provided outstanding service in tests by major airlines in accessory drive gear trains.

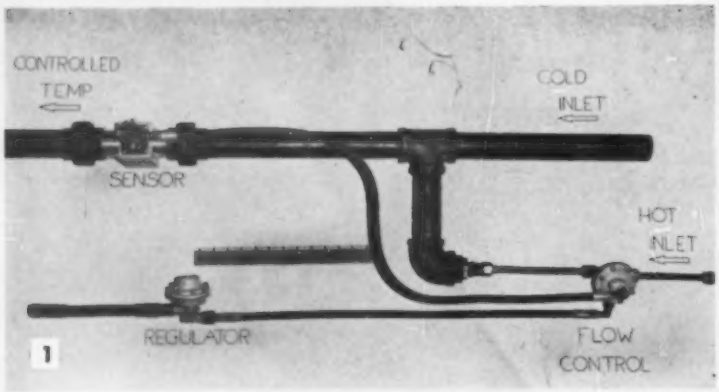
In Crankshaft Assemblies
Johns-Manville developed a special split seal to permit use of an economical flange-type crankshaft in a popular engine used in small planes.

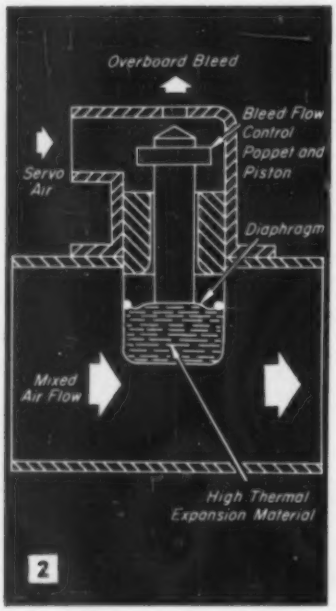
In Bearing Mechanisms—High sealability and low friction at high shaft speeds make Clipper Seals particularly suitable for clutch and transmission bearing mechanisms in helicopter rotors.

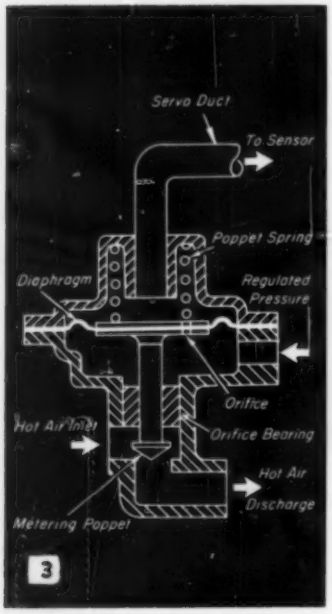
If you have an oil seal problem, Johns-Manville will be glad to help you solve it. For engineering help and free 28-page illustrated brochure PK-71A, write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

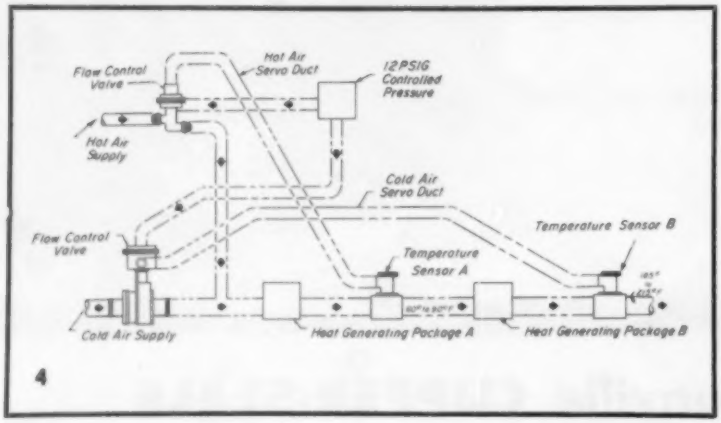
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CLIPPER SEALS









and temperatures of —100 to +60 F.

If temperature in the main duct or the cold air duct drops below 33 F, the high thermal expansion material in the sensing unit, Figure 2, contracts opening the overboard bleed. This decreases pressure above the diaphragm of the flow control valve, Figure 3, and allows the diaphragm and poppet to be forced upward to admit hot air to the main duct. Hot air admission point is located far enough upstream of the sensing element to insure mixing before flow reaches the sensor.

When temperature in the main duct rises due to introduction of the hot air, material in the sensor element expands and the sensor poppet begins to close. This, in turn, restricts air flow in the sensor duct and pressure on top of the flow-control valve diaphragm increases moving diaphragm and poppet downward to reduce the flow of hot air. If cold air temperature remains below 33 F, sensor and flow-control valves remain open at some intermediate position to maintain the mixed air temperature at 33 F.

FIG. 1. LAB MOCKUP, of a pneumatic temperature control system for maintaining air above a specified temperature.

FIG. 2. SENSING VALVE operates on expansion or contraction of high-thermal-expansion material in response to temperature changes. This moves the poppet to change the opening of the overboard bleed.

FIG. 3. DIAPHRAGM-OPERATED POPPET-TYPE FLOW-CONTROL VALVE has 12-psi air fed to the lower side of the diaphragm. Orifice in the diaphragm allows equalization of pressure on both sides of the diaphragm if the servo duct is closed. Opening of the servo duct by the sensing valve bleeds air from above the diaphragm and allows pressure to force the diaphragm upward to unseat the poppet. Hot air is then admitted to the cold air duct.

FIG. 4. MULTIPLE TEMPERATURE CONTROL of two heat generators is obtained by controlling both hot and cold air with two sensors and two flow control valves.

Great advances in design . . .

NEED THE ADVANCEMENT IN WEAR RESISTANCE PROVIDED BY FLAME-PLATING BY LINDE

Lockheed's F-104A Starfighter, newest weapon of the Air Force, is the most advanced airplane of its type. To give them the greatest possible resistance to extreme conditions, bearing surfaces *(arrows)* of hot air valves used in the F-104A are Flame-Plated with tungsten carbide. Flame-Plating provides the wear-resistant coating needed to withstand the high unit loading and temperature extremes jet plane parts undergo.

Stratospheric altitudes . . . supersonic speeds . . . extreme temperatures subject jet plane parts to almost incredible conditions of heat and abrasion. To assure perfect operation in all circumstances, bearings of hot air valves in the Starfighter are Flame-Plated. A tungsten carbide coating, applied by LINDE's unique method, is the only material tried that successfully eliminated galling and provided a low coefficient of friction over the required service life of the part. With the part Flame-Plated, practically no wear occurred. This LINDE process is now a regular production procedure.

Flame-Plating is LINDE's special process for protecting metal parts from wear, abrasion, and fretting corrosion. Tiny particles of tungsten carbide or aluminum oxide are literally *blasted* onto the metal surface. Since the temperature of the part being coated seldom exceeds 400 degrees F., there is little or no risk of changes in its shape or metallurgical properties. Flame-Plated coatings can be applied from .002 to .010 inches thick, and used as coated or finished to 0.5 microinches rms. Practically all metals can be Flame-Plated—aluminum, magnesium, molybdenum, titanium as well as copper and steel.

Your own design may be improved by Flame-Plating. Find out how, by writing for a copy of the booklet "Flame-Plating," F8065. Address Flame-Plating, Dept. AH-12, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

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TE-5

ENVIRONMENTAL CONTROL PANEL AND TWO COLD BOXES USED TO ATTAIN TEMPERATURES FROM AMBIENT TO −65°F IN MISSILE CONTROL COMPONENTS.

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HYDRAULIC
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VALVE ACCEPTANCE TEST PANEL FOR PNEUMATIC MISSILE SYSTEM COMPONENT TESTING.

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Custom designed test equipment built to your specifications, including complete environmental test facilities.
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SOME TERRITORIES OPEN FOR REPRESENTATIVES

CIRCLE 50 ON READER SERVICE CARD

An increase in temperature or pressure of the hot air supply will, of course, cause the temperature sensitive material to expand and close the sensor poppet and flow control poppet and thus regulate temperature of the mixed air. Variations in cold air temperature in this application result from changes in altitude or other conditions affecting atmospheric temperature. Hot air temperature is dependent upon engine loading and may vary from 250 to 600 F during the short time in which the plane goes from a steep climb into a dive.

• **Multiple System**—Another system using the same concepts and similar elements, Figure 4, is used on the B-58 to regulate two temperature levels at different points in the same duct. Here two heat generating packages are maintained at temperatures of 60-90 F and 185-215 F respectively. Hot and cold air inlet conditions are the same as in the previous example. Temperatures to be maintained represent points for most efficient operation of the two heat generating units.

Hot air control sensor is located immediately after the unit with the lower temperature requirement while the cold air control sensor is located in the air flow leaving the unit with the higher temperature requirement. Temperature of the air leaving in both cases is essentially the temperature of the air within the units. Since each unit is generating heat. these temperatures are dependent upon heat generated in the heaters as well as the air supplied to them.

If temperature of air leaving the upstream or low-temperature unit drops below 60 F, the hot air sensor signals the hot air flow control valve and the amount of hot air is increased to bring the temperature to the required value. When temperature at the cold air sensor exceeds 215 F, a signal is sent to the cold air flow control valve and the supply of cold air is increased.

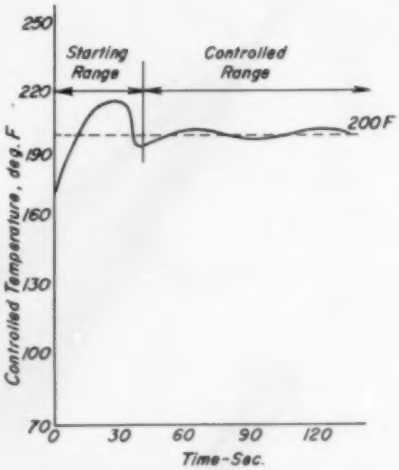


FIG. 5. TYPICAL RESPONSE of pneumatic temperature control system designed to maintain air temperature at 200 F. Overshoot from start is less than 10%. Full control is obtained in approximately 40 sec.

A gate-type flow control valve rather than the poppet-type is used for controlling cold air flow in this circuit because of the lower pressure drop through this kind of valve. Although sensitivity of the gate valve is somewhat less than that of the poppet type, decreased pressure drop warrants a sacrifice in sensitivity in this instance. Regulation within ± 4 deg F is possible with the poppet valve while ±7 deg F is maximum for the gate valve in this application.

• **Some Comparisons**—Although the systems discussed have a very definite weight advantage by comparison with other types at the present time, they do not permit any variation of controlled temperature through adjustment. Temperature control level is determined by the construction of the sensor elements. However, sensitivity of the system is well matched to the job, Figure 5. So it is not necessary to use time delay or anticipating elements to complicate the circuitry and further increase bulk of the system. ▼▼▼

AVIATION NEWS

from the fluid power field

The appointment of **C. Douglas Flanigen** as chief engineer was announced by **Lycoming Div., Avco Manufacturing Corp.** Flanigen was formerly chief engineer of **Utica Div., Bendix Corp.**

Dalmo Victor Co., Div. of Textron Inc., Belmont, Cal., has announced formation of a new hydraulics division, **R. J. Stahl,** formerly assistant to the president, has been appointed manager of the division.

Waldorf Instrument Co. Div., F. C. Huyck & Sons, appointed **Everett Gravenhorst** director of engineering of its fluid systems division.

Named as new manufacturing manager of the **Aero Hydraulics Division, Vickers Incorporated,** Detroit, Michigan, **William J. Herrman** has taken over the operation and direction of four Vickers plants located at Detroit, Mich., Joplin, Mo., Jackson, Miss., and Torrance, Calif.

Fort Worth—A hydraulic and pneumatic pressure test building with seven test cells was recently completed at Convair-Fort Worth. This facility will be devoted to research, development and components evaluation testing.

CDC Control Services Inc. have announced that one of their staff engineers, **Charles J. Stukas,** has been appointed Western Projects Engineer. Mr. Stukas can be reached through Luscombe Engineering Co., Pasadena, Calif., west coast representative of CDC.

William J. Herrmann
Aero Hydraulics Division, Vickers, Inc.

Ralph W. Barnes has been appointed to the sales staff of **Fluid Regulators Corp.,** Mentor, Ohio. Barnes was with **Sperry Gyroscope Div.** of **Sperry-Rand Corp.** for ten years.

Ralph W. Barnes
Fluid Regulators Corp.

Textron has acquired **Accessory Products Corp.,** Whittier, Calif., manufacturer of aircraft and missile components. Price was not disclosed.

REPORTS ON FLUIDS—

Wright Air Development Center, U. S. Air Force, has released two reports on hydraulic fluids:

A Sonic Shear Method for Determination of Shear Breakdown on Hydraulic Fluids and Lubricating Oils, PB 131012, By A. J. Gironda and others, March 1955, 24 pgs, 75 cents. A sonic test procedure was devised to accurately and rapidly estimate relative shear properties of hydraulic fluids and lubricating oils containing polymeric materials. All hydraulic fluids and some lubricating oils presently used in Air Force aircraft equipment contain high molecular weight polymers. The procedure utilizes a 10 KC magnetostrictive oscillator. Test fluids are subjected to sonic vibration for a specified time, after which viscosity measurements are taken to determine extent of molecular decomposition. Advantages of this test are speed and the very small quantities of fluid (30 to 50 cc) required.

Physical and Chemical Laboratory Evaluation of Experimental Silicate Base High Temperature Hydraulic Fluids, PB 131042, by H. M. Schiefer and R. J. Benzing, March 1957, 22 pgs, 75 cents. This report covers the laboratory evaluation of MLO-8200, a disiloxane base hydraulic fluid formulated in a research program toward development of a —65 to 400 F. fluid. MLO-8200 meets all of the specifications except rubber swell.

AVIATION COMPONENT DATA

Product Specification Catalog

. . . has been prepared to provide engineers and purchasing agents with complete data on the following: air loaded fuel pressure regulator; pneumatic flow control and reset valve; pressure control valve (pneumatic or hydraulic); pressure switches; pressure regulators. Engineering drawings, component application, general information and specifications are included.—*Wallace O. Leonard, Inc., Pasadena, Calif.*

CIRCLE 250 ON READER SERVICE CARD

Sub-Miniature Pressure Snubbers

. . . for 4000 psi

Snubbers made of stainless steel are designed for high pressures and temperatures in aircraft and missile fluid systems. The snubbers damp out high pressure surges and pump ripples in gages, pressure transmitters, pressure switches, pilot valves, and other instruments and controls.

Available as small as 11/16-in. x 1-1/16-in., typical weight is 0.037 lb for ¼-in. line size. Snubbers

may be used with hydraulic fluids, missile fuels and oxidizers, lubricating and engine oils, alcohol, water, and all other fluids compatible with series 300 stainless steels. Units are designed for systems with operating pressures up to 4000 psi; proof pressure 6000 psi; burst pressure 10,000 psi. Will operate at fluid and ambient temperatures from —65 to 400 F. Special models are available for temperatures to 1000F.—*A. U. Stone & Co. Inc., New York, N. Y.*

CIRCLE 251 ON READER SERVICE CARD

Relief Valve

. . . unaffected by back pressure

Balanced outlet relief valve provides pressure relief where high or variable downstream pressures

exist. Unit maintains constant crack and flow setting when variations in outlet pressure occur.

Valve has a spring loaded steel piston which includes the valve seat. Since upstream side of piston is exposed to upstream pressure, it is sensitive to it. Downstream side of piston is vented to atmosphere through the spring chamber. Fluid flows to outlet port through a tube passing through center of spring. In this design piston is balanced with respect to downstream pressure and unaffected by it. Steel poppet is semi-floating and lightly spring loaded on valve seat. A metal self locking nut on poppet stem provides adjustment of valve cracking pressure. Adjusting nut is keyed to valve body so that valve may be adjusted through outlet port with a screwdriver.

Valve operates at a pressure of 4000 PSIG maximum. Temperature range is —65 to 275 degrees F. Ports: AND 10050 standard. Available in ¼-in, ⅜-in or ½-in pipe or tube size. Fluid: MIL-O-5606 standard. Standard valve has free reverse flow; checked reverse flow available.—*Vinson Mfg. Co., Van Nuys, Calif.*

CIRCLE 252 ON READER SERVICE CARD

Hydraulic Impulse Test Stand

. . . for environmental tests

Testing of hydraulic components with controlled pulsations is provided by Model SX-89 Electro-Hydraulic Impulse Test Stand.

Unit tests hydraulic elements under simulated conditions of pressure and temperature up to 10,000 psi through an impulse range of 0 to 100 cpm. A system of solenoid valves produces a surge shock

condition in the element on test which is displayed as a waveform on a cathode ray oscilloscope. Pressure is stabilized using a nitrogen charged hydraulic accumulator.

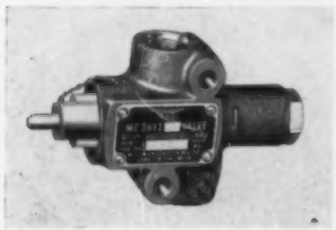
Test components are mounted in a safety-glass lidded test chamber with all controls and instrumentation conveniently arranged. The test chamber is equipped with an automatic CO_2 extinguishing system to eliminate fire hazard.—*Sun Electric Corp., Aeronautical Div., Chicago, Ill.*

CIRCLE 253 ON READER SERVICE CARD

Relief and Controllable Valve

. . . is very compact

Intended primarily for use in a pneumatic sequencing system, the MC-2652 valve is poppet type, with a relief valve in the reverse flow



direction. It conforms with applicable sections of specs MIL-P-5518A and MIL-P-8564. Ambient temperature range is —65 to 250 F, operating pressure 1000 psi, burst pressure 3750 psi minimum. With 300 to 1000 psi at pressure port, internal leakage is limited to 3cc per hour maximum. Extremely compact in design, the valve weighs only .20 lbs. Port connections are for ¼-in. tubing.—*M. C. Mfg. Co., Lake Orion, Mich.*

CIRCLE 254 ON READER SERVICE CARD

Pneumatic Regulator

. . . eliminates spring mechanism

Designated RV-23, ¼-in. dome loaded pneumatic regulator utilizes gas pressure for hand operation or three 18 to 30 vdc solenoids for remote control operation. Unit eliminates cranking characteristic of hand loaders, offers wide inlet and outlet pressure ranges, is compact and versatile. Can be integrated into pneumatic systems requiring operation at different pressure level sequence. A 62 degree turn of the control knob in either direction loads or vents the hand operated model to any set pressure. Amount of angular deflection controls rate. Inlet pressure is 500 to 4500 psig; proof pressure 6750 psig; burst

Continued on page 128

power for hydraulic systems

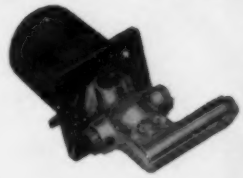
comes in small packages

Eastern Aviation Hydraulic Pumps are the smallest and lightest line of pumps ever made. They supply as much as one gallon of fluid per minute against pressures as high as 2000 PSI.

The 1700 Series of high speed gear pumps have theoretical displacements varying from .0021 to .0251 cubic inches per revolution. This series of pumps can be close-coupled directly to various electric motors. They are made in many configurations with and without integral bypasses. A variety of bearing combinations handle different types of fluids and operating pressures.

Eastern engineers can adapt and design hydraulic pumps to meet your specifications. On your next project, contact Eastern for engineering help that really helps.

Eastern 1700 SERIES PUMPS



1733-HBU-249

1731-LCU-205

1781-HBV-255

1700 SERIES PUMP

Send for Aviation Bulletin 340

Eastern INDUSTRIES, INC.

100 SKIFF ST. • HAMDEN, CONN.

CIRCLE 36 ON READER SERVICE CARD

AVIATION COMPONENT DATA

9000 psig. Outlet pressure range 50 psig to 50-200 psig below inlet pressure; proof pressure 6000 psig; burst 8000 psig. Rated capacity .1 (SCFM/PSIA) min.—*Marotta Valve Corp. Booton, N. J.*

CIRCLE 255 ON READER SERVICE CARD

Products and Services

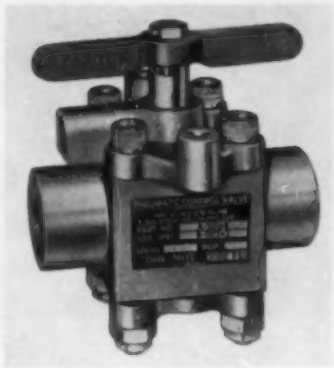
. . . available from the various aviation divisions are listed in new 32-page booklet. Services include engineering, tools and special equipment. Among products covered are hydraulic actuators, servomechanisms, hydraulic control systems. *Booklet, Kelsey-Hayes Co. Detroit.*

CIRCLE 256 ON READER SERVICE CARD

Rotary Valve

. . . has no leakage

Leakage at all pressures is eliminated in this rotary valve through the use of a teflon shear seal principle. Designed for fluids or gases under operating pressure of 3000 psi, the proof pressure is 4500 psi and burst pressure is 7500 psi. Valve is full ported straight through for minimum pressure drop. Handle torque at operating pressure is less than 45 inch pounds. Handle rotates 90 degrees for full on or full



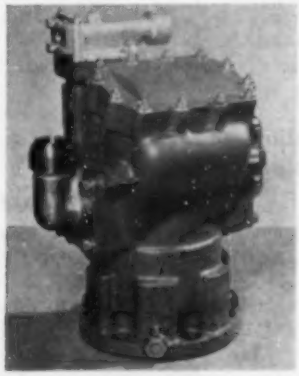
off. Detent stops are provided in both positions and flow is bi-directional. Temperature range is —65 to + 275 degrees F.—*Vinson Manufacturing Co., Van Nuys, California.*

CIRCLE 257 ON READER SERVICE CARD

Variable Piston Pump

. . . tolerates contamination

Capable of continuous operation at 4000 psi, pump features contaminant tolerant design—it permits



successful operation in hydraulic fluids with particle sizes up to 40 microns. The pump uses standard variable piston design—axial pistons reciprocating in a revolving cylinder block supported by a trunnion-mounted yoke. Pump delivery is varied from zero to maximum by changing the angle of the yoke.—*Vickers, Inc., Detroit, Mich.*

CIRCLE 258 ON READER SERVICE CARD

SEALOL research raises sealing limits with new METAL BELLOWS seal!

Another major sealing advance, the development of a *metal bellows seal*, is Sealol's answer to the extremely high temperature requirements demanded in the production of missiles, rockets, and ultrasonic speed aircraft. The design features of these seals also offer great potential in the more difficult commercial sealing applications.

CHECK THESE FEATURES . . .

- Temperature and pressure limitations dictated only by available materials.
- Designed to handle temperatures in excess of 800° F range.
- Elastomers (an aging factor) have been eliminated; unlimited *shelf-life*, always ready for service.
- Available material selections meet extremely high or low temperature—pressure and/or corrosive conditions . . . 300 and 400 series stainless steel, Inconel, etc.
- Relatively small space requirement . . . approximates present standard Sealol Seal geometry. (Sealol Bulletin #7)

ACT TODAY! Request complete data on these amazing new seals. Let the Sealol Engineer, the seal expert, show you how this new milestone in sealing can benefit you. Write or phone:

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CIRCLE 92 ON READER SERVICE CARD

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City _____ Zone ____ State _____

PLEASE SEND ME ADDITIONAL INFORMATION AND LITERATURE ON ITEMS CIRCLED BELOW.

1	18	35	52	69	86	103	120	137	154	171	188	205	222	239	256	273	290	307	324
2	19	36	53	70	87	104	121	138	155	172	189	206	223	240	257	274	291	308	325
3	20	37	54	71	88	105	122	139	156	173	190	207	224	241	258	275	292	309	326
4	21	38	55	72	89	106	123	140	157	174	191	208	225	242	259	276	293	310	327
5	22	39	56	73	90	107	124	141	158	175	192	209	226	243	260	277	294	311	328
6	23	40	57	74	91	108	125	142	159	176	193	210	227	244	261	278	295	312	329
7	24	41	58	75	92	109	126	143	160	177	194	211	228	245	262	279	296	313	330
8	25	42	59	76	93	110	127	144	161	178	195	212	229	246	263	280	297	314	331
9	26	43	60	77	94	111	128	145	162	179	196	213	230	247	264	281	298	315	332
10	27	44	61	78	95	112	129	146	163	180	197	214	231	248	265	282	299	316	333
11	28	45	62	79	96	113	130	147	164	181	198	215	232	249	266	283	300	317	334
12	29	46	63	80	97	114	131	148	165	182	199	216	233	250	267	284	301	318	335
13	30	47	64	81	98	115	132	149	166	183	200	217	234	251	268	285	302	319	336
14	31	48	65	82	99	116	133	150	167	184	201	218	235	252	269	286	303	320	33.
15	32	49	66	83	100	117	134	151	168	185	202	219	236	253	270	287	304	321	338
16	33	50	67	84	101	118	135	152	169	186	203	220	237	254	271	288	305	322	339
17	34	51	68	85	102	119	136	153	170	187	204	221	238	255	272	289	306	323	340

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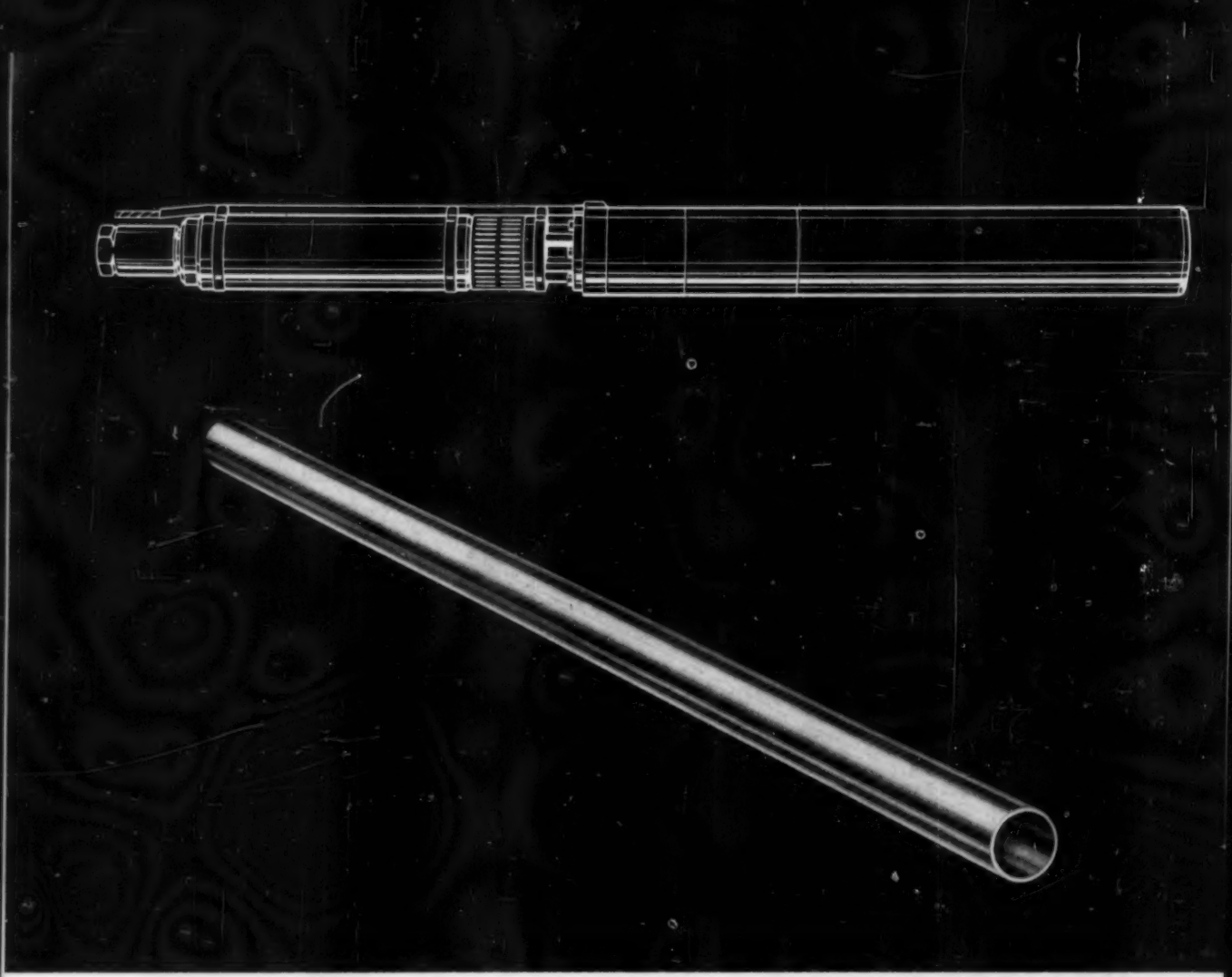

B&W ERW Mechanical Tubing Saves Time, Cuts Pump Production Costs 50%!

One manufacturer of submergible pumps had a bottleneck in its production line. The company had been using seamless tubing for their motor housings and pump housings—the design of the units called for precision tubing with close I.D. tolerances.

The company turned to B&W Electric-Resistance-Welded Mechanical Tubing.

After two years of using this close tolerance tubing, company engineers estimate they have been able to reduce their production costs on the components as much as 50%. What's more, the production of these parts has become the least troublesome in the manufacturing process!

Here's another example pointing out where B&W ERW Tubing is being used by industry to produce better products at lower cost. B&W Mechanical Tubing is available in a wide range of sizes, shapes, analyses, and finishes.

Get all the facts on savings from Mr. Tubes, your link to B&W. Call your local B&W tubing distributor. Write for Bulletin TB-419. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA-6088-M4

Seamless and welded tubular products, seamless welding fittings and forged steel flanges — in carbon, alloy and stainless steels

CIRCLE 16 ON READER SERVICE CARD

CIRCLE 1 ON READER SERVICE CARD

only the Fall Gets it All!

CLOSED JOINT

WHY be satisfied with only partial removal of dirt or other foreign accumulation from piston rods when you can—

Remove ALL the Dirt from Rod O.D. Stop Dirt Passing Through the Ring Joint with a

Fall "CJ" WIPER RING

The Ring with a Closed Joint!
SPRING LOADED
with Squeeze Grip Action

If you have a wiper ring problem write, wire or phone us.
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You Can Depend on ACE Products—Established 1885!

IMMEDIATE DELIVERY

contour cutters for popular hydraulic ports!

AN10050, regular
AND10050 heavy duty for stainless & steel
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MS33514

One pass completes all operations necessary to produce the port contour. Job time cut as much as ⅔! All have carbide cutting edges for long life, smooth finishes. Available in all sizes. Write for prices.

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Tool and Mfg. Co.
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California

New Products continued

ELECTRIC MOTOR

. . . saves space

Designation: Uniclosed

Features: Motor has rugged, compact construction, advanced electrical design, and offers savings in space of as much as 46%.

Specifications: Motor is drip-proof, has 2-way ventilation system, ventrifoil for efficient direction of air and deflection of water, improved asbestos insulation, and dynamically balanced, solid cast rotor. External parts are cast iron, including split-type outlet box.

U. S. Electrical Motors, Inc.
Los Angeles, Calif.

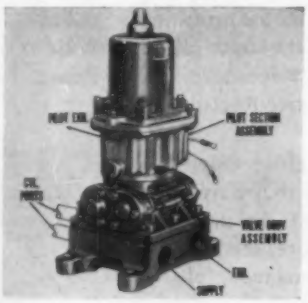
CIRCLE 197 ON READER SERVICE CARD

PILOT-OPERATED AIR VALVE

. . . uses oil-immersed solenoid

Designation: Goldmodel

Features: Designed with a large capacity pilot section actuated by an oil-immersed solenoid. Spring returns to normal operation or locks in actuated position. A 90° turn of the actuator locks solenoid in energized position.



Specifications: Built to JIC Standards, with locking manual actuator. Valve bodies include straightway, normally open and normally closed; three way normally open and normally closed; in the in-line series, and 3-way and 4-way in the base-mounted series.

Ross Operating Valve Co.
Detroit, Mich.

CIRCLE 198 ON READER SERVICE CARD

PISTON-TYPE ACCUMULATORS

. . . feature improved sealing

Application: In addition to functioning as a power reserve, units are being used more and more for shock absorbtion purposes.

Features: Has new design v-o-ring of synthetic rubber for improved sealing. Oil capacity of the line ranges from 10 cu. in. to 10 gal., and inside diameter sizes are from 2 in. to 7 in. All models furnished with SAE straight thread connection ports; adapters for other style connections are available. Units can be mounted in any position.

Parker Hydraulics Division
Parker-Hannifin Corporation
Cleveland, Ohio

CIRCLE 199 ON READER SERVICE CARD

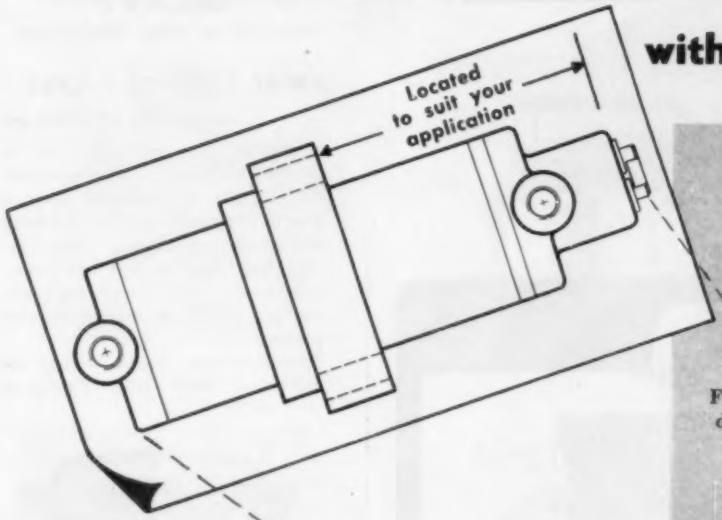
ROTARY ACTUATOR

. . . has integral servo valve

Features: Rotation of the input shaft by a very small force causes the output shaft to rotate to the same angular position. Output shaft exerts a high force depending upon size of actuator and supply pressure. Only two hydraulic connections are needed because control valve is integral. Input shaft may be driven

Continued on page 132

"We Saved 25% of the Cost of Base Castings"

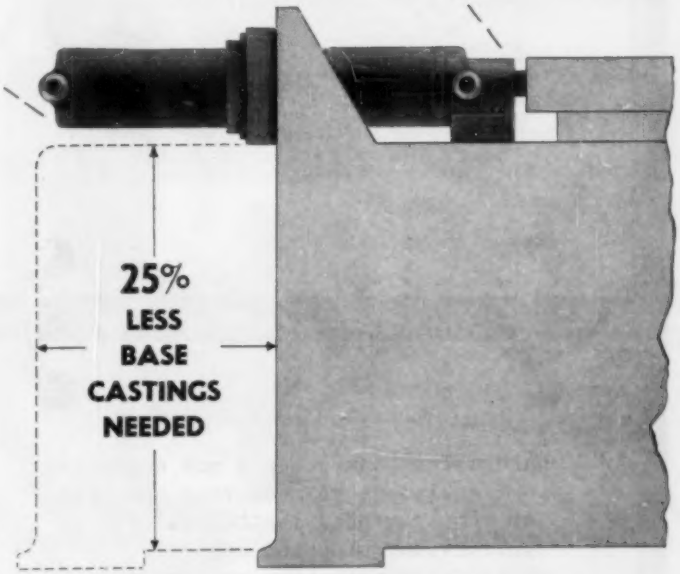


with **Pathon**

INTERMEDIATE FLANGE MOUNTING HYDRAULIC CYLINDERS

Application of the Pathon Intermediate Flange Mounting, as shown by the simplified drawing below, saved this machine company 25% of their base casting cost. Bonus advantages included reduced shipping weight, easier handling, and the universally recognized operating efficiency inherent in all Pathon Cylinders.

With Pathon Intermediate Flange Mounting Cylinders you choose whichever mounting position best suits your specific needs. Various heads of other mounting types may be combined with the intermediate flange to provide a large number of combination mountings. Thus special mounting brackets are eliminated. The cylinder is rotatable to any position for connecting pipe ports and mounting puds. Pathon Cylinders are available in the R. H. 2000 P.S.I. Series and the Q.H. 1000 P.S.I. Series.



HAVE YOU A HYDRAULIC CYLINDER MOUNTING PROBLEM?

The chances are that one of the standard eight Pathon Hydraulic Cylinder mounting types or their combinations will adequately fill it. However, on any unusual Cylinder problem, we will be glad to help you reach a solution. Don't hesitate to write us.

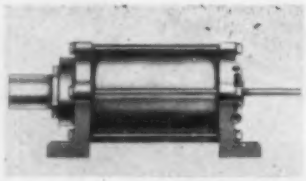
Pathon MANUFACTURING CO.

3823 PACIFIC AVE. — CINCINNATI 12, OHIO

New Products continued

manually with a handwheel, cable etc. or electrically by a servo motor, synchro or rotary solenoid. Low input force requirement eliminates need for error amplifiers.

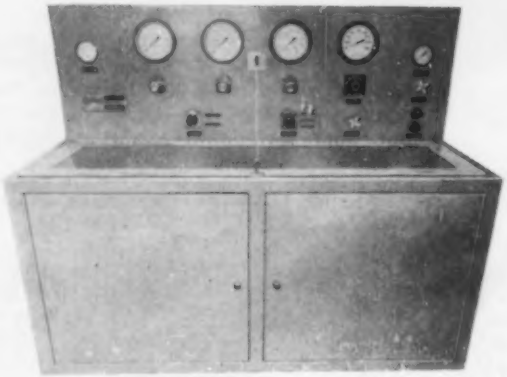
Specifications: Six sizes from 4-in. diam by 2½ in. long to 12-in. diam by 13 in. long are available. Output torques vary from 7,500 in.-lb to 360,000 in.-lb. at 1000 psi supply pressure. Rotation is 270 deg or if doubled torque output is required, rotation is 95 deg.



Industrial Control Products Inc.
Caldwell, N. J.

CIRCLE 200 ON READER SERVICE CARD

CARDWELL CUSTOM
HYDRAULIC TEST STAND



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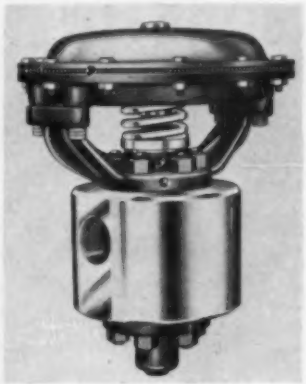
The CARDWELL MACHINE COMPANY
Franklin at 19th St., Richmond 11, Va. • Phone MIlton 4-4593

3-WAY CONTROL VALVES

. . . for use at 6000 psi

Features: Designed for use on equipment requiring extremely high operating pressures, such as plastic molding, ceramic forming, and similar equipment. Valves provide fast response, leak-free operation and smooth, shock-less opening and closing at maximum rated pressure.

Specifications: Valve bodies are machined from solid aluminum bronze stock. Sleeve-type construction with replaceable, hardened stainless steel seat sleeve insert in valve body assures perfect alignment of valve stem and seats at all times. Available in ½ through 2-in. NPT sizes. Valve diaphragm is actuated by 35 to 40-psi air.



Sinclair-Collins Valve Co.
Akron, Ohio

CIRCLE 201 ON READER SERVICE CARD

IMPULSE COUNTER

. . . records pressure changes

Features: Said to be particularly useful for determining fatigue life in pressure vessels, the unit automatically counts pressure impulses between predetermined limits. It can be used in either pneumatic or hydraulic systems.

Specifications: The counter measures 2⅞ x 1½ x 1 1/3" and is designed for a maximum working pressure of 2500 p.s.i.

Dunlop Rubber Co., Ltd.
London, England

CIRCLE 202 ON READER SERVICE CARD

SPECIAL HYDRAULIC PUMP
. . . for use in oil wells

Designation: Model 1731-HFJ-235
Application: Designed for use at the bottom of oil wells thousands

of feet underground. Pump supplies high pressure oil in a special purpose oil well tool.

Features: Unit operates in an ambient of up to 20,000 psi at temperatures of from 350 to 450 degrees F. and is completely balanced to eliminate loads caused by the high pressures.

Specifications: Maximum dimensions are 2 3/16" x ¾" x 2 5/16. Weight is one pound.

Eastern Industries, Inc.
Hamden, Conn.

CIRCLE 203 ON READER SERVICE CARD

OIL COOLER—RESERVOIR
. . . combines both units

Application: Ideal for low volume requirements such as in portable hand-held tools and small machine tool attachments. Device is a natural base for mounting other compo-

nents in forming a compact power unit.

Features: Contains a radiator-like arrangement of tubes which have a total usable capacity great enough to take the place of a conventional

Continued on next page

NEW fulflo

all-steel valve . . . for greater safety!

Install it . . . Forget it
For dependable pressure control

New Fulflo all-steel piston type, oil relief hydraulic by-pass valves combine proven features with the advantages of all-steel construction in flange models up to 2" pipe size. They are quiet, non-chattering because of shear-closing action. They offer greatest safety . . . even when subjected to extreme heat. Priced right for original equipment use . . . built right for superior replacement service.

THE FULFLO COMPLETE LINE

- **Standard and flanged models**
- **Steel, cast iron or brass bodies**
- **Pipe sizes to 2½"**
- **Just 6 springs for pressures to 500#**
- **Brass, steel or stainless pistons**
- ***Specials* to your requirements**

Specify FULFLO for Positive Automatic Pressure Control

Write for free helpful reference:
"FULFLO VALVES MECHANICAL DATA BOOK"

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Avenue, Blanchester, Ohio

TRADE MARK FULFLO REG U S PAT OFF

CIRCLE 42 ON READER SERVICE CARD

New Products continued

tank. Hot oil drawn through the tube system is cooled by two electric fans which force air over the tube surfaces.

Specifications: Unit has a heat transfer rating of 12 hp. with a capacity of only 5 quarts.

The Rosaen Co.
Hazel Park, Mich.

CIRCLE 204 ON READER SERVICE CARD

SELECTOR VALVE

. . . permits multiple operation from single power source

Designation: AV-1

Features: Selector valve allows two or more open center control valves or banks of valves to be used for several independent hydraulically actuated operations form a single power source. Valve is an automatic, hydraulically balanced three port type. Fluid entering the central port flows through both outlets until such time as a back pressure difference of predetermined value is encountered. This causes the valve to automatically shift, permitting the oil to flow only through outlet having the greater back pressure. Device offers fail-safe feature—since valve seeks the line that has the greatest back pressure, it automatically closes the flow to any leaking line. Designed for 10,000 psi operation, modification for lower pressure systems will be available.

Manco Mfg. Co.
Bradley, Ill.

CIRCLE 205 ON READER SERVICE CARD

PRESSURE AND LIQUID LEVEL TRANSMITTER

. . . measures up to 250 psi

Designation: Model P-06

Features: Suitable for services involving viscous fluids or materials which solidify in the static lines of conventional pressure transmitters.

The transmitter is capable of measuring pressures up to 250 psi or ranges from 0 to 100 inches of water. Operating on the force-balance principle, it transmits a linear 3-15 psi signal to a recorder, indicating gage or manometer. Only part which contacts the measured material is the corrosion-resistant diaphragm of the unit.

Conoflow Corp.
Philadelphia, Pa.

CIRCLE 206 ON READER SERVICE CARD

Continued on page 136

Make Good Design Even Better . . .

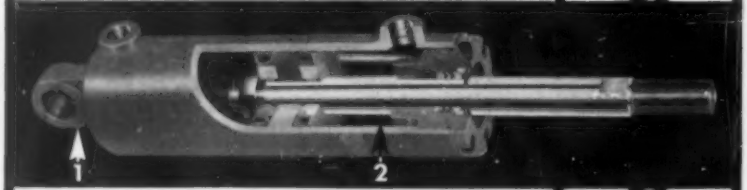
BHEW Made-to-Order HYDRAULIC CYLINDERS

Whatever your cylinder requirements, you're sure of dependable operational performance with efficient, close-tolerance BHEW cylinders that require minimum mounting space. Built to meet your specifications, their cost is reasonable; there is no charge for tooling; they are delivered on schedule.

BHEW CYLINDER FEATURES: • Standard and special designs available. • Double or single acting and telescopic. • 1½" to 8" bore. • Strokes up to 156". • Smallest possible O. D. and retracted O. A. length. • Oil cylinders with 1,500 psi or 3,000 psi working pressure, pneumatic up to 150 psi. • Cup-type, ring-type or O-ring construction. • Choice of mounting.

Double-Acting 2-piece Piston Rod Cylinder. It is excellent for extending and retracting boom arm. Both hoses are connected on rod end. →

1. Hinged mount for alignment.
2. Honed steel cylinder.



WRITE for your copy of Hydraulic Cylinder Engineering Reference Data Manual. Can save you hours of time in specifying cylinders. 40 dimensioned basic designs for general and special purpose double acting cylinders.

BHEW BENTON HARBOR ENGINEERING WORKS, Inc.

622 LANGLEY AVENUE, ST. JOSEPH, MICHIGAN

Here's a control valve that assures you

leak-proof service

Highly-lapped metal-to-metal surfaces of this Nicholson control valve assure you leak-proof service. The O-ring stem packing and O-ring seal between the body and base make joints leak-proof without excessive bolt tension.

You can use the Model 300 with air, water, hydraulic fluid or oil as the pressure medium . . . at operating pressures to 300 psi. Use it to activate single- or double-acting cylinders. Simple and rugged, this valve provides accurate, repeatable control of equipment such as presses, hoists, clutches and chucks. Valve maintenance is no problem . . . all stem, base and disc bearing surfaces are lubricated through one easily accessible fitting on top of valve stem. Lubricant reservoir in base reduces frequency of lubrication.

No need to stock valves or parts for service with different pressure mediums. This valve's *one* combination of corrosion-resistant materials—bronze body, aluminum-bronze base, stainless-steel disc, hard chrome-plated stem—is well suited for all of the most commonly used pressure mediums. It's available in three pattern sizes covering five standard pipe sizes from ¼" to 1" . . . small enough and light enough to be supported by connected piping.

For a 3- and 4-way control valve that will give you leak-proof, trouble-free operation, specify Nicholson. W. H. NICHOLSON AND COMPANY, 14 OREGON ST., WILKES-BARRE, PA. Sales and Engineering Offices in 98 principal cities.

Write for Bulletin 300 . . . covering design, construction, sizes and applications for the Model 300

NICHOLSON

OF WILKES-BARRE

CIRCLE 71 ON READER SERVICE CARD

BELMONT
hydraulic packings

WATERPROOF FLAX

Belmont 300 Series Hydraulic Packing is constructed of the best quality line flax, braided solid, treated with a waterproof lubricant, firmly formed to size and surface graphited.

Ideal for heavy duty hydraulic services such as accumulators, rams, presses, plunger pumps on cold water, oil.

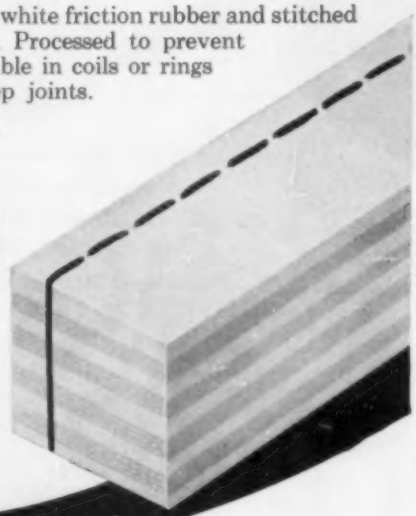
Supplied in 3 grades—hard, soft, very soft. And in coil, spiral or rings with butt joints.

WHITE FRICTION

Belmont Series 10 Hydraulic Packing is constructed to withstand hard service on inside-packed pump pistons and as end rings on plungers and rams in combination with other packings such as Belmont Series 300 shown above. For hot or cold water and oil.

Made of fine sheeting and white friction rubber and stitched with strong linen thread. Processed to prevent excessive swelling. Available in coils or rings with butt, bevelled or step joints.

Write for Catalog No. 56.



ask your BELMONT Distributor

such leading Packing Distributors as:

Manning Packing & Supply Co. in Portland, Oregon
and
Harry P. Lee, Inc. in Orlando and Miami

are ready to serve you promptly and helpfully, wherever you are.

The Belmont Packing & Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

BELMONT

New Products continued

SHUTTLE VALVE
. . . for remote control

Application: Valves offer a simple way of providing for charging and discharging of pressure cylinders from remote control stations.

Features: Air from the valve that is being actuated is prevented from

escaping to the atmosphere through the exhaust ports of the non-actuated valves. Special anti-extrusion kinetic O-ring seals provide air-tightness after more than three million cycles of operation.

Specifications: Available in ⅛", ¼", ⅜" and ½" NPT sizes, for pneumatic or hydraulic control.

Versa Products Co., Inc.
Brooklyn, N. Y.

CIRCLE 207 ON READER SERVICE CARD

EXPLOSION-PROOF SWITCH
. . . has double conduit openings

Designation: EX 1 series

Application: Unit is said to reduce installation costs in applications that require through wiring.

Features: Switches carry full Underwriters' Laboratories Listings for hazardous atmospheres of Class 1, Groups C and D, and Class 11, Groups E, F and G. They have adjustable roller-arm actuators with

non-sparking rollers. Aluminum alloy housing of the series has room for wiring through both conduit openings.

Specifications: Can be supplied for use with either ½ in. or ¾ in. diameter conduit. Single-pole single-throw and double-pole double-throw contact arrangements are available.

Micro Switch Div.
Minneapolis-Honeywell Regulator Co.
Freeport, Ill.

CIRCLE 208 ON READER SERVICE CARD

TEMPERATURE CONTROL

. . . has wide range

Designation: Type D95

Features: Unit is composed of two integral assemblies: a remote bulb thermal device, and control head with connecting capillary tube of varying length. Control head, with attached bellows, is free for placement away from source to be controlled.

Specifications: Head compensation is effective from —65 to 160 F. Models are available with adjustable range spans of —150 to 650 F with on-off differentials of approximately 1° and 2° F. Available normally open, normally closed, and double throw with no neutral, rated for 15 amps at 115/230 a-c. All switches are single pole suitable for 180 F ambient temperatures.

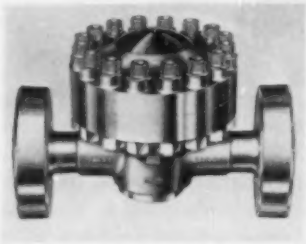
United Electric Controls Co.
Watertown, Mass.

CIRCLE 209 ON READER SERVICE CARD

PRESSURE REGULATOR

. . . to 6000 psi

Features: Valve provides very accurate flow and pressure control. Features include: identical line and



orifice sizes from ¼-in to 3-in; inlet pressures from 0 to 6000 psi; outlet pressures from 0 to 5500 psi; positive shut-off; balanced poppet for low seat load. Unit has wide

Continued on next page

CIRCLE 32 ON READER SERVICE CARD

RUGGED, HEAVY-DUTY
HYDRAULIC CYLINDERS

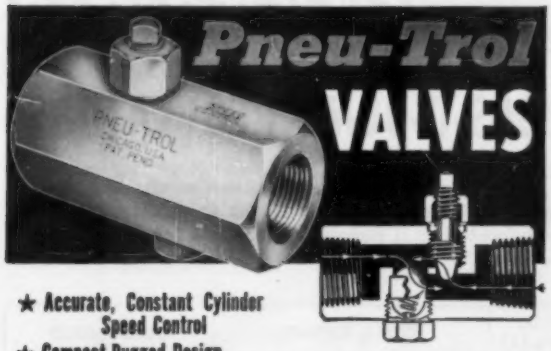
Attention: O. E. M. Prompt delivery on any quantity . . . high quality . . . low cost!

Built-in Mechanical Stroke Control

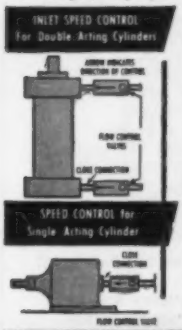
Free catalog and engineering survey, no obligation.

WRITE...PHONE...WIRE
CROSS MFG. CO.
LEWIS ■ PHONE 86 ■ KANSAS

Pneu-Trol VALVES



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves, are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

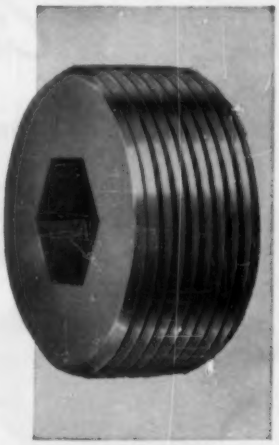
Pneu-Trol DEVICES, INC.
1426 N. KEATING AVENUE • CHICAGO 51, ILL.

CIRCLE 79 ON READER SERVICE CARD

specify standard

UNBRAKO

Dryseal-thread Pressure Plugs for hydraulic or fuel systems



Use them wherever liquids or gases must be contained under pressure—or in place of ordinary pipe plugs. UNBRAKOs seal without compound. They are made of the same high-strength alloy steel, have the same internal wrenching feature as UNBRAKO socket screws. Fully formed threads exceed NPTF specifications. Standard sizes—⅛ to 1¼ in.—are stocked by your authorized industrial distributor. See him for details. Or write Unbrako Socket Screw Division, STANDARD PRESSED STEEL Co., Jenkintown 2, Pa.

UNBRAKO SOCKET SCREW DIVISION
STANDARD PRESSED STEEL CO.
SPS
JENKINTOWN ■ PENNSYLVANIA

CIRCLE 101 ON READER SERVICE CARD

CIRCLE 7 ON READER SERVICE CARD

Hydraulic CYLINDERS

to specification

AT your service — since 1918 — the most modern machine tools to handle up to 15" I. D., including the last word in honing equipment and the most accurate of precision gauging equipment. Everything we do is to specification. Expanded facilities permit prompt delivery of 1 or 1000 pieces in any material desired.

Call Erie 2-3664 - Send specifications to

AMERICAN HOLLOW BORING COMPANY

1954 Raspberry St., Erie, Pa.

New Products / continued

range of fluid media—air, gasses and liquids; a temperature range —65 to 250 degrees F.; flanged, pipe, tube or custom end connections, internal or downstream sensing control. Available in stainless steel, aluminum, alloy steel and bronze.

Accessory Products Corp. Whittier, Calif.

CIRCLE 210 ON READER SERVICE CARD

MOTOR STARTERS

. . . are compact, versatile

Designation: Type H

Application: For full or reduced voltage starting, reversing or non-reversing, dynamic braking or multi-speed control of squirrel cage, synchronous or wound rotor motors.

Features: Completely front accessible, basic unit measures 34-in wide by 32-in deep. Starter is available with either air break or oil immersed contactors up to 1500 hp at 2300 v. or 3000 hp at 4600 v. Short circuit protection of 150,000 kva at 2300 v. and 250,000 kva at

Control Gases to 10,000 P.S.I.

WITH VICTOR GAS-O-DOME REGULATORS

VICTOR'S LONG EXPERIENCE IN PIONEERING HIGH PRESSURE GAS REGULATION *is yours for the asking. For details, and complete data on Gas-O-Dome Regulators, see your VICTOR dealer or write us for catalog 341. Dealer inquiries invited.*

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment, hardfacing rods; blasting nozzles; cobalt & tungsten castings.

844 FOLSOM ST. • SAN FRANCISCO 7 21

Gas pressure, not springs, control diaphragm motion to give you precise regulation of high-pressure gases at high or low flow rates. Can be remotely controlled if desired. Safety valve furnished on request. More than 55 stock models in the following series:

GAS-O-DOME SERIES	DELIVERY RANGE (p.s.i.)	SPECIAL FEATURES	GASES HANDLED
GD 30	0-2500	High Delivery Flow Rates. Accurate Valve Control.	Air, Argon, Helium, Hydrogen, Nitrogen, Oxygen —and others non-corrosive to bronze and stainless steel.
GD 31	0-3600		
GD 61B	0-2500	Excellent Capacity. Compact— 7 lb.— 4" x 6" x 6". —67° to +160° F. Range.	
GD 62B	0-3600		
GD 80	0-5000	Accurate Valve Control. —67° to +160° F. Range.	
GD 81	0-10000		
GD 10	0-500	Self-Relieving Pilot Regulator Control. High Flow Rates.	
SR 10	0-1000	High Pressure, Low Flow. Compact—4 lb. —2" x 6" x 6".	
SR 100	0-30 & 0-40	Corrosion Resistant.	Ammonia (wet or dry) Boron Trifluoride Chlorine (wet or dry) Hydrogen Sulfide, Hydrogen Chloride, Sulfur Dioxide—and other corrosive gases.

4160 or 4600 v. is provided by current limiting fuses. Manufacturer tested the separate components and the completed starter to prove ratings and mechanical strength.

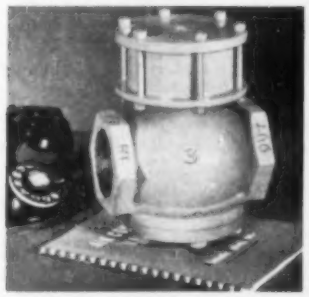
Allis-Chalmers Manufacturing Co.
Milwaukee, Wis.

CIRCLE 211 ON READER SERVICE CARD

PILOT-OPERATED VALVES

. . . are simple and compact

Application: Valves are especially suitable for the oil and chemical fields and on diesel-engine controllers. Normally closed or normally open, valves can be used with air, oil, water or vacuum, for pressures 0-500 psi. Remote control operation is accomplished on the principle of balanced and unbalanced



flow line pressure. When the pilot pressure and line pressures are equalized the poppet piston closes. Static line pressure then assures positive shut-off. Valves are noncorrosive, self-compensating, have only one moving part for tight shut-off and compact size.

Airmatic Valve, Inc.
Cleveland, Ohio

CIRCLE 212 ON READER SERVICE CARD

TIME DELAY RELAY

. . . has octal plug adapter

Designation: Plug-in Agastat

Features: Octal plug feature adapts the Agastat time delay relays to products and machines using plug-in components. The octal plug is wired internally to the timer to allow immediate installation and operation. Optional timing adjustments are needle valve or dial head type, variable from 0.1 second to 15 minutes.

Specifications: Units can be supplied for continuous AC duty at all standard voltages from 6 to 550 volts, 60 cycles and 25 cycles. They are available for continuous or intermittent DC service at all standard voltages from 6 to 230 volts.

A'G'A Division
Elastic Stop Nut Corp. of America
Elizabeth, New Jersey

CIRCLE 213 ON READER SERVICE CARD

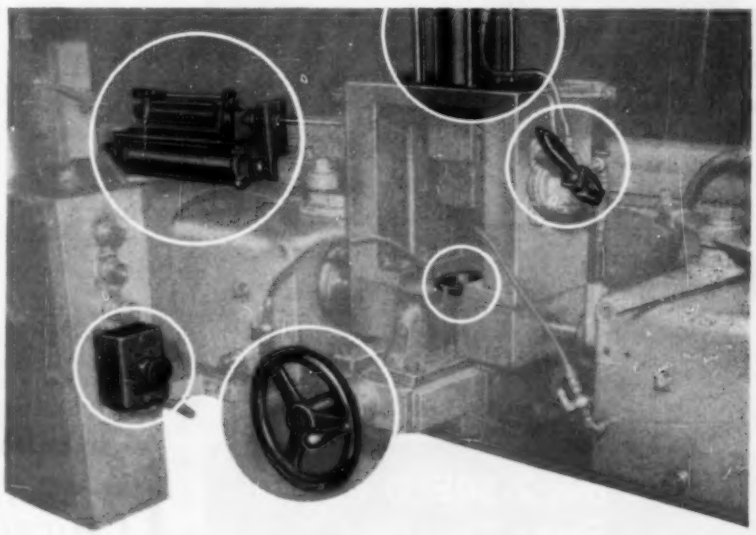
HIGH-TEMPERATURE SWITCH

. . . has ceramic case

Designation: S9-4

Features: Switch operates in an ambient temperature range of —100 to 900 degrees F. and has a prob-

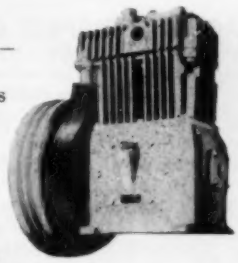
Continued on next page



COMPRESSED AIR
accurately locates and drills pistons on this machine

LOW-COST AIR POWER supplied by a Quincy Compressor pays this manufacturer in speed, precision and actual dollar savings. Piston to be drilled for piston pin is placed in fixture, valve at right is opened, and air cylinder at top moves locating tool down into position. Piston is then clamped for drilling with a quick turn of the wheel at front. Switch at operator's left actuates horizontal air cylinders which feed drills through piston pin holes, return them automatically.

Complicated set-ups and simple ones, long production runs and short ones,— all can employ low-cost air power to advantage. Quincy makes compressors for industry from 1 to 90 C.F.M. For help with your compressed air applications in machines and manufacturing, address Dept. AH-127.

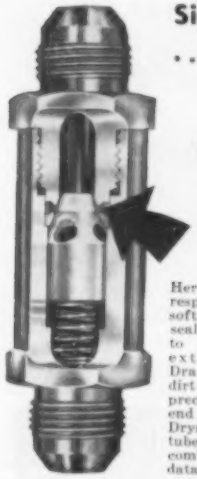


Quincy COMPRESSORS

QUINCY COMPRESSOR CO. • QUINCY, ILLINOIS

CIRCLE 83 ON READER SERVICE CARD

CIRCLE 58 ON READER SERVICE CARD



Simple, Secure ... Leak-Tight! this FLEXIBLE SEAL SEAT*

Here's the secret . . . responsive action of the soft, long-lasting O-ring seal! Instantly compresses to seal internal and external pressures. Draws harmlessly around dirt particles. No costly precision parts or extra end seals. Six standard Dryseal pipe and JIC tube sizes; 12 connection combinations. Send for data sheet.

KEPNER PRODUCTS COMPANY
7321 West 59th Street • Summit, Illinois

Kep-O-seal

HYDRAULIC & PNEUMATIC
CHECK VALVES

* PATENT APPLIED FOR

New Products continued

able life of 750,000 cycles of operation. Mechanism is the manufacturer's standard single pole, double throw two circuit design with a special ceramic case for high heat resistance.

Specifications: Switch case measures 1¼" long and has standard .101 diameter mounting holes. Rating is 5 amps 125/250 V.A.C., 30 V. D.C. Ind.

Electro Snap Switch & Mfg. Co. Chicago 24, Ill.

CIRCLE 214 ON READER SERVICE CARD

METAL HOSE FITTING . . . saves time

Designation: Type DT

Features: Fitting has three parts, uses a solid one-piece ferrule and metal-to-metal seat. New specially formed concentric grooves and ridges in the internal flat seat of the end connector are said to make it unnecessary to smooth the flat end of the flexible tubing. Advantages claimed are a saving in time

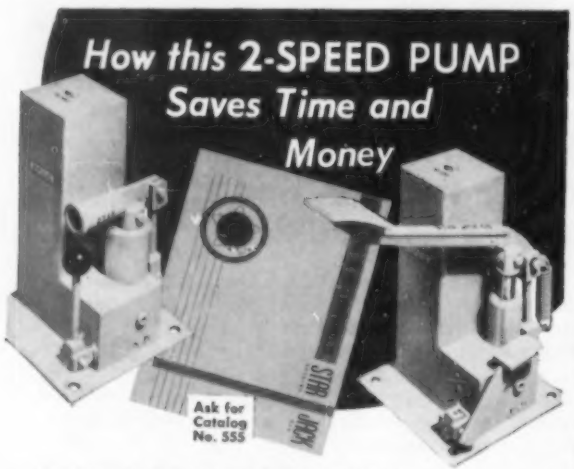
and a perfect seal without the use of gaskets or packing rings.

Specifications: Standard DT male fittings for Seamlex Tubing from ¼" I.D. to 1" I.D., are available in standard pipe sizes from ¼" to 1" N.P.T. inclusive.

Seamlex Co., Inc. Long Island City, N. Y.

CIRCLE 215 ON READER SERVICE CARD

How this 2-SPEED PUMP Saves Time and Money



STAR Hi-Lo 2-SPEED PUMP (hand or foot model) operates at high speed, brings ram to load 6 to 15 times faster than a single speed pump, then automatically changes over to high pressure. Maximum capacity 10,000 psi.

SPEEDS WORK, SAVES EFFORT

Safety overload valves, oil capacity 160 cu. in. or larger, chrome plated concentric pistons 1¼" and ½", 1½" and ½", 2" and ½", all with 1½" stroke.

Special engineering counsel and proposals cheerfully submitted on request.

Representative areas available.

STAR JACK CO., INC.
420 LEXINGTON AVE., Dept. AH, N.Y.C. 17
PLANT: RIVER GROVE, ILLINOIS

PNEUMATICS SHEFFER HYDRAULICS
HYDRAULIC CYLINDERS

C4H Series

- 2000-3000 psi
- All Steel Construction
- Meets or Exceeds J.I.C.
- 12 Bore Sizes—1⅛—12
- Removable Rod Cartridge
- Finest of the "Interchangeables"

Write for Bulletin #1256

THE SHEFFER CORP.
CINCINNATI 15, OHIO
MOST COMPLETE LINE OF CYLINDERS IN THE INDUSTRY

CIRCLE 102 ON READER SERVICE CARD

CIRCLE 93 ON READER SERVICE CARD

CIRCLE 53 ON READER SERVICE CARD

"Wipe out" PACKING FAILURES WITH Seal-Guard METALLIC ROD WIPERS

Self-adjusting, easy to install, Seal-Guard's knife-like bronze rings "wipe off" all dirt and grime, will not mar the rod, are oil and heat resistant and friction-free.

HOW SEAL-GUARD WORKS

1. Twin wiper rings are mounted on rod with notches staggered.
2. Cushion ring is compressed on assembly exerting constant inward pressure keeping ring in constant contact with rod.
3. Harmful substances are completely cleared by scraper action.

Seal-Guards are available to fit rod diameters from ¼ to 24 inches. Other sizes by special order.

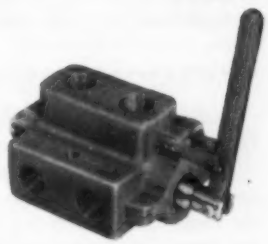
WRITE FOR DESCRIPTIVE LITERATURE.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Rd. Van Dyke, Mich.

DOUBLE SELECTOR VALVE

GRESEN HYDRAULICS

A NEW GRESEN PRODUCT NOW AVAILABLE
Model DS-75



FEATURES: Cast iron body—pressure balanced spool—Easy to mount—Chrome plated spool—Optional three handle positions.

SPECIFICATIONS: Capacity—24GPM @15 ft/sec.
Pressure range —0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

Write for literature

GRESEN MANUFACTURING CO.
405-35 Ave. N. E. Dept. A-127 Minneapolis 18, Minn.

YOUNG HEAT EXCHANGERS

for plastics molding presses . . . . . dissipate hydraulic heat

Rear view of an HPM 100-ton plastics transfer molding press.

Eliminates Carbon Deposits in Pumps and Maintains Viscosity of Hydraulic Oils . . .

To insure proper dissipation of hydraulic heat, the above plastics press was equipped with low cost Young Type "F" Heat Exchangers. Heat is built up as liquid plastic at 300 to 500° F. is forced into the mold chamber. Under this action Young Coolers maintain a maximum operating temperature of 115° F. in the hydraulic fluid. This heat removal is accomplished with minimum pressure drop using a minimum of water. Young Heat Exchangers also prevent the possibility of carbon formation in pumps. Available in fixed or removable tube bundle models for either fresh or salt water service.

Write Dept. 447-M for FREE Catalog

Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS
Executive Offices: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

CIRCLE 46 ON READER SERVICE CARD

CIRCLE 124 ON READER SERVICE CARD

Post Scripts of Industry

News about people, manufacturers and sales organizations

Roger N. Burgess
Howell Electric Motors Co.

Matthew J. Betley
Titeflex, Inc.

Mark T. Gilkison
Gates Rubber Company

Appointment of **Roger N. Burgess** as manager of field sales has been announced by **Howell Electric Motors Co.**, Howell, Mich. The new post has been established by Howell to expand and strengthen customer service. **H. D. Lewis** succeeds Burgess as Detroit district manager.

Matthew J. Betley has been named president of **Titeflex, Inc., Springfield, Mass.** He was formerly vice president and general manager of Aeroquip Corp., Jackson, Mich.

William M. Kerrigan, formerly of the Aircraft Products Division at **Standard Pressed Steel Co.,** Jenkintown, Pa., is now manager of **Flexloc** sales in the locknut department. **Frank R. Lindh** became assistant manager of Flexloc sales. Kerrigan's appointment fills the position left vacant by the recent promotion of **John J. Wiest** to the new post of technical director of the locknut department.

H. U. Rogness, Inc. has moved to new office and warehouse facilities at 1419 11th Avenue South, Minneapolis, Minnesota.

Mark T. Gilkison was appointed as manager of the industrial sales division for **Gates Rubber Co.,** Denver, filling a vacancy left by **L. L. Carroll** who took on sales duties for Gates on the west coast.

Jerome M. Pendell has been appointed advertising manager of **Racine Hydraulics & Machinery, Inc.**

Ernest Ritchie Co., 1305 South Ivanhoe Way, Denver 22, Colo., was appointed as exclusive sales representative by **Tuthill Pump Co.,** Chicago. **Phillips W. Berg** was made regional sales manager of Tuthill.

•••••••••••••••••••••••••

Paul L. Reed who is well known to the readers of APPLIED HYDRAULICS is retiring this month. Paul was editor of AH from its start in 1948 to 1956 when he became responsible for the editorial direction of AERONAUTICAL PURCHASING. His plans aren't at all retiring. Paul is fulfilling his ambition to own a family of small-town newspapers and finish a military history for book publishers Little, Brown & Company.

•••••••••••••••••••••••••

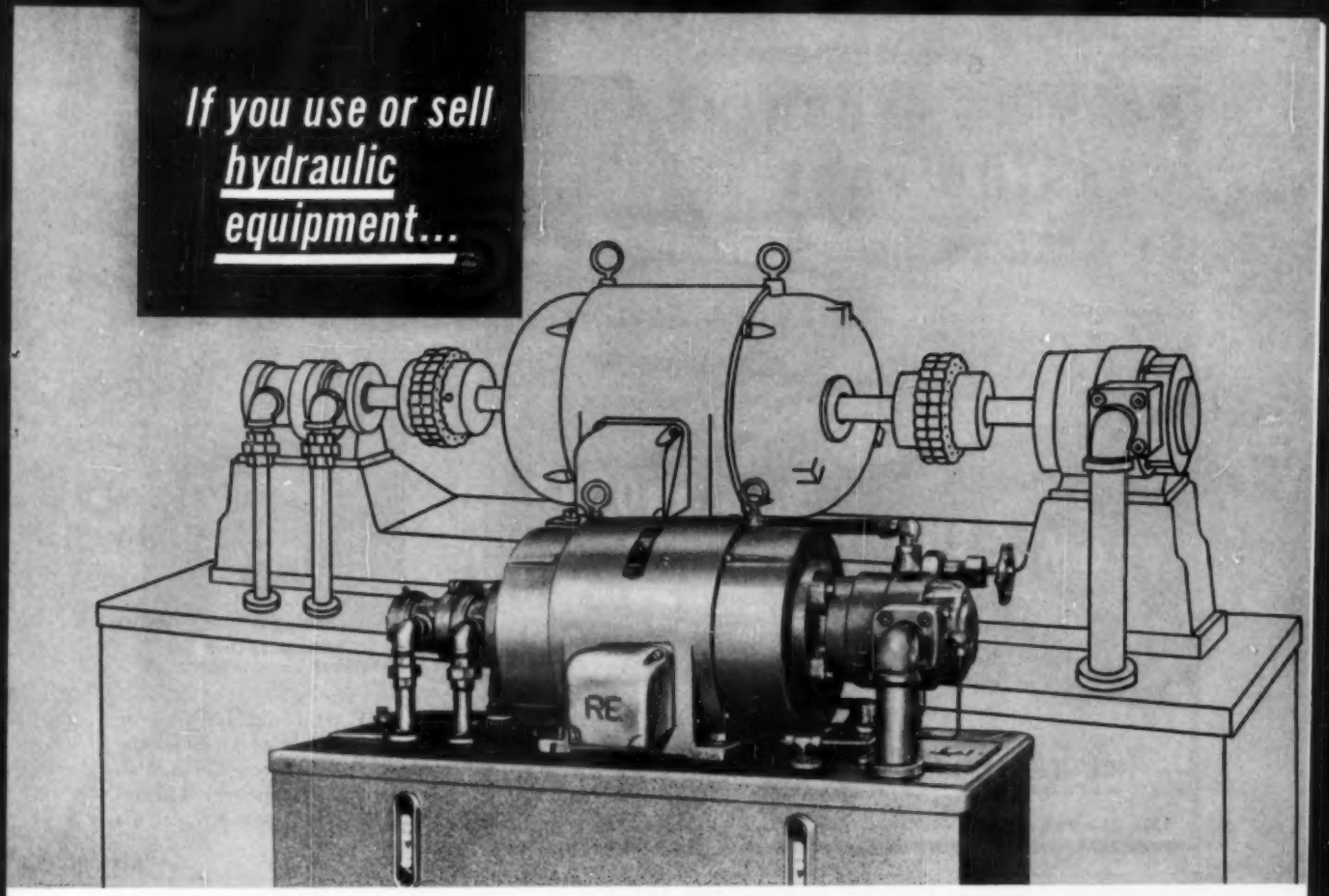
John D. Watson, president of **Hein-Werner Corp.,** Waukesha, Wis., announced these appointments: **Mark L. Marino** to handle industrial sales in the hydraulic assembly field, and **Frank Kovich** as assistant to the president.

Franchisement of **Swan Engineering & Supply Co.,** 3251 Fairfax Road, Kansas City 15, Kansas, as distributor of Parker o-rings and other molded synthetic rubber parts has been announced by **Parker-Hannifin Corp.,** Cleveland, Ohio.

Continued on page 44

Circle 88 ⟶

If you use or sell hydraulic equipment...



...cut space needs almost 50% with REULAND spline-coupled hydraulic pump mount motors!

Pump and motor become *one* with the new Reuland spline-coupled hydraulic pump hook-up. The pump shaft is connected directly to the motor's shaft *inside the motor.* Flexible couplings are eliminated... pump mount platforms are eliminated... and the tank length can be reduced because almost 50% less mounting area is required. Compact appearance is beautiful.

SPEEDY INSTALLATION

Pump-to-motor hook-up is merely a matter of seconds. All you do is slip the spline coupling onto the pump shaft...and attach the pump to the endbell. This spline coupling is supplied with the motor and is precision mated for each make of pump. There's no time wasted tinkering around...takes only a fraction of the ordinary time.

PRECISION ALIGNMENT

Alignment is perfect *automatically* whether the installation is made out in the field or on the production line. This permits even unskilled workmen to handle this simple task without error. Also, by hooking the pump up at the point of bearing support, within the motor, vibration is reduced to a new minimum. Operation is smooth, quiet.

COSTS LESS...SAVES INSTALLATION LABOR... FITS ALL PUMPS

The Reuland spline-coupled unit is priced lower than a conventional set-up... saves you extra money by reducing installation costs. What's more, we can supply it to fit any make of pump you may be using. So sure are we that it will be of help to you, we are offering to engineer a demonstration unit to *your* equipment, without the slightest obligation. These units are our best salesmen.

OUR NEW GENERAL CATALOG WILL COME IN HANDY–SENT FREE ON REQUEST.

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: Alhambra, California
EASTERN DIVISION: Howell, Michigan
DISTRIBUTORS IN ALL PRINCIPAL CITIES

*Trademark Registered

CIRCLE 6 ON READER SERVICE CARD

BEARING • BUSHING
WEARING PART
FORMULAS

developed specifically for

your requirements

PROMET ENGINEERED BRONZE

does not powder in severest service nor cut or stick to the shaft because of temporary lubrication failure.
Write for literature and service data sheets, or send prints and condition of operation for recommendations and quotations.

THE American Crucible PRODUCTS CO.

1303 Oberlin Avenue — Lorain, Ohio, U. S. A.

Post Scripts of Industry
continued

Richard T. Orth has been appointed vice president of planning for **Sanders Associates, Inc.**, Nashua, N. H.

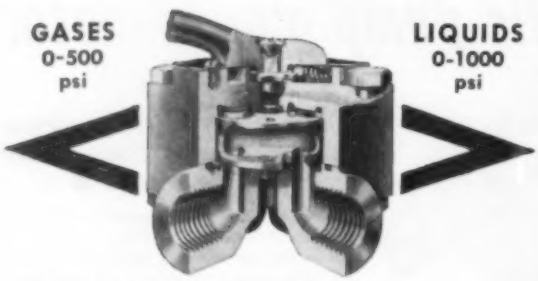
Richard T. Orth
Sanders Associates, Inc.

W. E. Hobson, Jr. has been named field engineer in the Alabama, Florida, Georgia and Mississippi area for **Spencer Thermostat Div.** of **Metals & Controls Corp.**

REPUBLIC

New SEAL-TITE VALVES
PRESSURE BALANCED

GASES 0-500 psi



LIQUIDS 0-1000 psi

- ⅛" to 1" FPT
  −65° to 160°F
- 2, 3, 4-way
- Turning ease
- Zero leakage
- Increasing pressure tightens seals.
- Positive flow control

Ask for Catalog No. 356

Distributors in principal cities coast to coast

CHECK RELIEF PLUG GLOBE NEEDLE

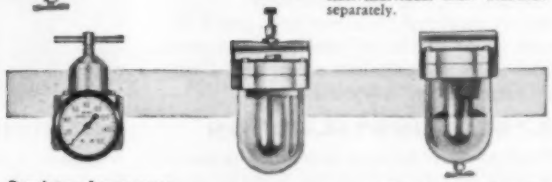
189

RM REPUBLIC MANUFACTURING CO.
15655 BROOKPARK ROAD • CLEVELAND 11, OHIO

AIR-MITE
FILTER—REGULATOR
Oil Unit

- Instantaneous response to demand
- Special Filter for cleaner air
- Accurate injection of pre-atomized oil

The new AIR-MITE unit is designed and built for maximum operating efficiency, easy maintenance and long life Operates at pressures to 160 psi. Available in ¼", ⅜" and ½" T.P. sizes. Individual units available separately.



Regulator—Incorporates piston cup instead of diaphragm. Provides more accurate, stable regulation, lasts longer. Direct reading gauge for close regulation of outlet pressure.

Lubricator — Automatically pre-atomizes and feeds oil mist into air stream. Simple micro adjustment permits accurate balance of oil-to-air supply.

Filter — Porous sintered bronze element filters better . . . won't collapse . . . is easy to clean. Built in air baffle. Brass drain cock.

Write for catalog sheets and prices.

AIR-MITE Devices, Inc.

4401 W. KINZIE • CHICAGO, ILLINOIS

CIRCLE 85 ON READER SERVICE CARD

CIRCLE 4 ON READER SERVICE CARD

James A. Kyffin has been appointed director of purchases and traffic for **C. A. Norgren Co.**, Englewood, Col.

Formation of **Hoke-Manostat Corp.**, 148 South Dean St., Englewood, N. J., was announced by **Donald B. Salmon**, president. The new corporation has been organized to market precision industrial instruments developed by **Manostat Corp.**, and manufactured in part by **Hoke, Inc.**

Walter H. Brown was named midwest sales coordinator by **Standard Pressed Steel Co.**, Jenkintown, Pa. **Thomas A. Breen**, district salesman for seven years, succeeds Brown as Chicago district sales manager.

Walter H. Brown
Standard Pressed Steel Co.

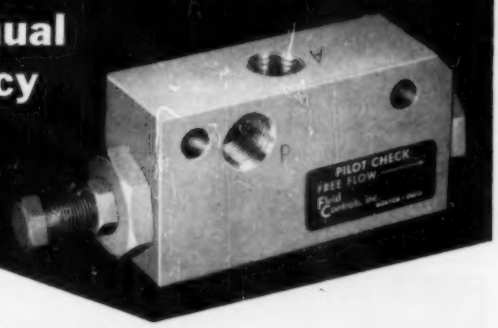
Thomas A. Breen
Standard Pressed Steel Co.

Square D Co. has named **Daniel H. Miller** manager of its western division, with headquarters at Los Angeles. Miller was formerly northwest regional manager of Square D at the Seattle, Wash. plant.

Continued on next page

CIRCLE 40 ON READER SERVICE CARD

NEW! PILOT CHECK VALVE
with manual emergency release



. . . locks cylinder without leakage, but can be released manually in emergencies.

Feature also available on double pilot check valves.

- For oil to 3000 psi.
- ¼", ⅜" & ½" pipe connections

Write for detailed information

Fluid Controls, inc.
Member of NFPA

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

BRIGGS IS THE "OIL WATCH DOG" ON THE LARGEST FOUR DIRECTIONAL STRETCH PRESS IN THE WORLD

BIG OPERATIONS, like this, forming a portion of airfoil for the DC-8 jet liner require technical knowledge and experience. Briggs engineers have the experience to back long performance records of Briggs Hydraulic Filters. Write for fully illustrated manual showing various hydraulic systems and plans.

INSTALLED AT DOUGLAS AIRCRAFT LONG BEACH DIVISION PLANT

SHERIDAN PRESS OPERATING AT DOUGLAS AIRCRAFT PLANT, BRIGGS FILTERS ARROWED.

Briggs
PIONEERS IN MODERN OIL FILTRATION

HYDRAULIC OIL FILTERS

PRODUCT OF PUROLATOR RESEARCH

FILTER/SEPARATORS

WRITE FOR HYDRAULIC MANUAL. NO COST.

THE BRIGGS FILTRATION COMPANY
DEPT. 223, WASHINGTON 16, D. C.
Yes, send manual, no obligation.
Name .....
Company .....
Address .....

CIRCLE 22 ON READER SERVICE CARD

Post Scripts of Industry
continued

Briggs Filtration Co., Washington, D. C., has appointed **Creole Engineering Co.** as representatives for industrial sales in Louisiana and Mississippi. Manager will be **Ben Louviere,** 130 Harrison Ave., P. O. Box 12115, New Orleans, Louisiana.

Fornaciari Co., Los Angeles, Calif., has announced its appointment as Southern California distributor for the **Oil Hydraulic Div.** of the **Webster Electric Co.,** Racine, Wisconsin. The combination of Webster components with the design-engineering facilities of the Fornaciari Hydraulic Div. has expedited delivery of standard or special-design hydraulic systems to Southern California manufacturers.

ASSURED
ALUMINUM SHIPPER PLUG
protection
There's none better than the accepted standard — Tubing Seal Cap metal protective closures for aircraft hydraulic lines and assemblies. For fifteen years, Tubing Seal Cap has made the best closure protection for handling, shipping and storage.
TUBING SEAL CAP, INC.
for complete catalogue of sizes, styles and prices.
TUBING SEAL CAP, INC.
808 West Santa Anita, San Gabriel, California
EASTERN OFFICE:
428 New Center Bldg., Detroit 2, Michigan

Ralph W. Palmer has been named technical sales manager of **John S. Barnes Corp.,** Rockford, Illinois.

Bob Bester has been named to the new post of sales planning and merchandising manager of Surgepruf hose and couplings by **Alemite Div., Stewart-Warner Corp.** Bester previously was with **Anchor Coupling Co., Inc.**

Greer Hydraulics, Inc., New York, has appointed **John H. Gillingham** director of industrial relations.

John H. Gillingham
Greer Hydraulics, Inc.

New York Air Brake Company has promoted **Robert F. Hodgson** to manager of sales and engineering of the Kalamazoo Division. **Walter S. Root** has been appointed manager of industrial sales of the division.

R. W. Fletcher has been named manufacturer's representative in the Southern California area for **American Crucible Products Co.,** Lorain, Ohio.

Ernest N. DeLalla has been promoted to vice-president in charge of sales for **Cox Sales & Engineering Co.,** Detroit, Michigan.

Appointment of **John C. Abbey** as chief engineer of the Jackson engineering department has been announced by **Aeroquip Corp.** In his new assignment Abbey will direct all development engineering activities at Aeroquip's new engineering center at Jackson, Mich.

John C. Abbey
Aeroquip Corporation

Marsh Instrument Co., Skokie, Ill., has appointed **Don L. Warner** sales representative in the Philadelphia area. Territory is eastern Pennsylvania, New Jersey, District of Columbia, Maryland and Delaware. The new Marsh sales office in Philadelphia is also under his direction.

Harold F. Ehrhart was promoted to plant manager of the **Lunkenheimer Co.,** Cincinnati, Ohio.

Harold F. Ehrhart
Lunkenheimer Co.

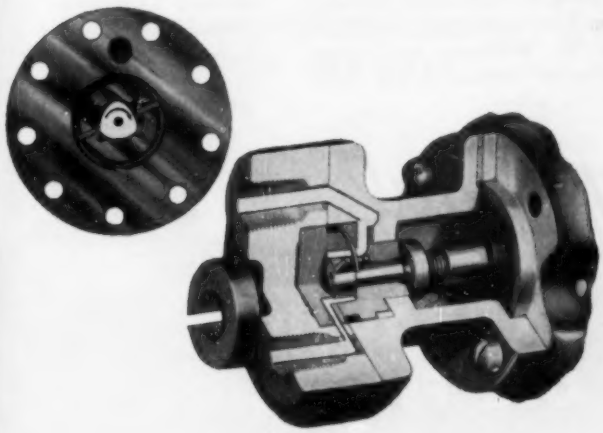
Square D Company, Detroit, Michigan, has named **Lawrence G. Maechtlen** as first vice president.

Continued on next page

WELDON

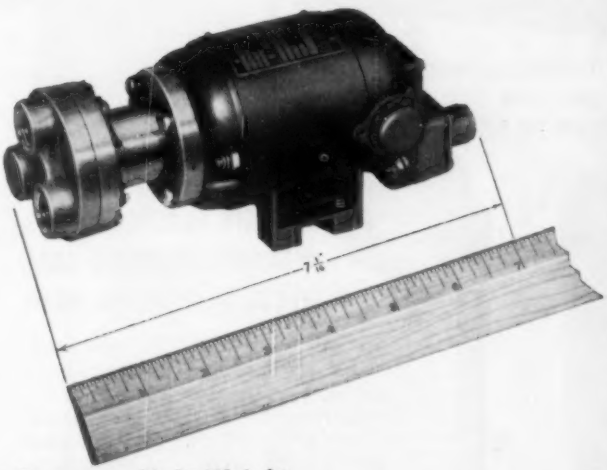
FLUID METERING PUMPS

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.



Compact • Light Weight

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD · · · CLEVELAND 4, OHIO

CIRCLE 120 ON READER SERVICE CARD

CIRCLE 89 ON READER SERVICE CARD

Post Scripts of Industry
continued

Vickers, Inc., Detroit, announced appointment of **Calvin A. Bock** as application engineer in the Cleveland office, and **Wallace W. Williams** was named application engineer in the Rockford, Ill. office.

Graton & Knight Company, Inc., has purchased the **Warren Belting Company;** it will be operated as a division of Graton & Knight Company, Inc. These appointments have been announced: **George L. Abbott,** president of Graton & Knight Company, Inc.; **Hans Anderson,** general manager of Warren, and **Robert M. Abbott,** sales manager of the leather division. **John G. Henrikson** continues as vice president in charge of sales at Graton & Knight.

Harold Horton has joined the **Rucker Co.,** Oakland, Calif., as systems application engineer. Horton specializes on hydraulic and pneumatic testing and control apparatus for the industrial, petroleum, electronics, aircraft and missiles industries. He formerly headed up the hydraulics division of Cardwell Machine Co., Richmond, Virginia.

Harold Horton
Rucker Co.

Extruded Products Division of Stillman Rubber Co., Fullerton California, has moved into a new 10,000 sq ft building alongside present facilities. This completes an expansion program that has increased production capacity by 100 per cent.

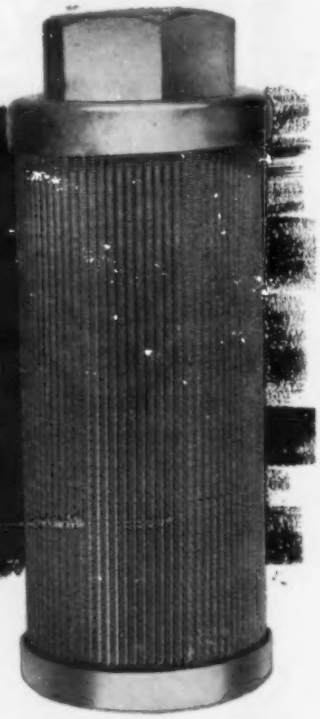
John T. Castles has been appointed sales manager for the **Silicone Products Dept.** of **General Electric.** Formerly manager of rubber market development, Mr. Castles succeeds **Jerome T. Coe** who has become the department's marketing manager.

Midwest Hydraulics Co. was appointed stocking distributor in Chicago, Ill., for **L & L Mfg. Co.,** Detroit, Mich. **Machinery & Machine Supplies Co.** was named stocking distributor in New York, with office and shipping facilities at 305 East 47th St.

Capital

HYDRAULIC OIL FILTER with Monel Metal Insert

Reservoir Type for Hydraulic and Oil Re-circulating Machinery



EASY TO INSTALL—EASY TO CLEAN
LONG LIFE—LOW COST—SIZES AND SCREENS TO FIT YOUR NEEDS

★ ONLY THREE PARTS
★ MEETS J.I.C. STANDARDS
★ GREATER FILTERING AREA
★ SPECIAL TRAP-WEAVE MESH

Specially woven MONEL wire cloth and a new method of compact corrugation, gives triple protection with less space than other filters of like capacity. Trap-weave mesh stops thin, elongated particles with NO loss of efficiency.

Non-corrosive, non-toxic materials throughout. Easily cleaned with an ordinary brush.

Write for descriptive circular.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

CIRCLE 89 ON READER SERVICE CARD

NEW CONCEPT IN HYDRAULIC OIL FILTERS

Tell-Tale® Filters are full flow. They tell when they're dirty, by-pass oil if not cleaned. The filter cartridge is easily removed.

SEE condition of oil thru glass
FULL FLOW by pass when filter is clogged
TELLS when to clean, by remote signal switch
EASY access to dirty cartridge

PATENTS APPLIED FOR

Attention Dealers—write us for more information.

ROSAEN Tell-Tale inlet and return line filters come in sizes for 100, 50, 20, and 5 gpm (shown) use, with limit switches (above), or visual indicators (left). The Tell-Tale filter concept is a proven one, setting new standards in hydraulic maintenance. Write for more information today.

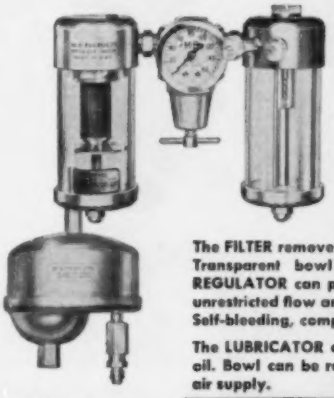
The ROSAEN COMPANY
1776 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

CIRCLE 65 ON READER SERVICE CARD

GREATER PROTECTION to your AIR LINE!

M-B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00[illegible] and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

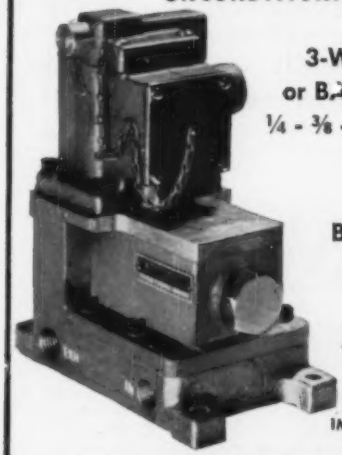
The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M-B PRODUCTS
46 VICTOR AVE., Div. 10
DETROIT 3, MICHIGAN

Solenoid Operated AIR VALVES
conform to all J.I.C. Standards

Stop Your Solenoid Troubles with AV VALVES Designed & Engineered for Many, Many Millions of Trouble Free Operations & Backed by 1 Year UNCONDITIONAL GUARANTEE



3-WAY IN-LINE
or BASE MOUNTED
¼ - ⅜ - ½ - ¾ - 1 - 1¼

• • • •

4-WAY
BASE MOUNTED
¼ - ⅜ - ½ - ¾

COMPLETE LINE OF AIR CONTROL VALVES

STOCKING REPRESENTATIVES IN IMPORTANT INDUSTRIAL CENTERS

Write for Bulletin and New Low Prices

AUTOMATIC VALVE CO.
37419 GRAND RIVER AVE., FARMINGTON, MICH.

TRU-O-SEAL STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

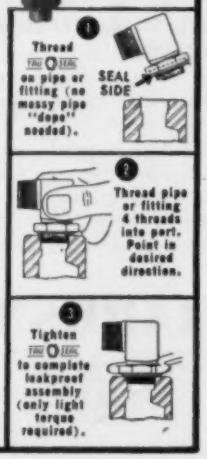
$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

Send order to

TRU-O-SEAL DIVISION
Flick Reedy Corp

2008 N. Hawthorne, Melrose Park, Illinois

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

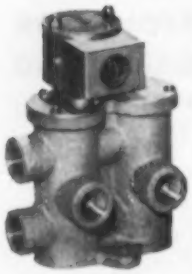

1
Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed).
SEAL SIDE
2
Thread pipe or fitting 4 threads into port. Point in desired direction.
3
Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

CIRCLE 14 ON READER SERVICE CARD

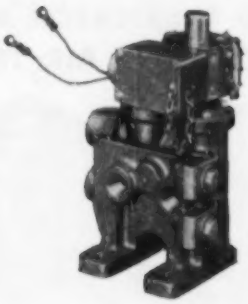
CIRCLE 106 ON READER SERVICE CARD

Crescent® Solenoid Valves

COMPETE ON PRICE
LEAD IN SERVICE LIFE



Standard 4-Way



J.I.C. Type 4-Way

Standard 3-Way

® 4-Way and 3-Way Solenoid operated, pilot controlled valves for Air, Water and light oil to 150 P.S.I., products of Crescent Valve Co.

NO COIL BURNOUT

because a generous power margin, short solenoid travel and pilot operation combine to prevent overheating and overloading. Note that these valves are accepted and used in automotive plants where assembly line production does not permit coil or valve failure.

LONG SERVICE LIFE

Main valve design is aimed at extremely long trouble free service. Resilient seats are tight sealing and are not affected or damaged by dirt or grit because they are of a self scavenging design. Witness their superior performance in such severe service as operating hopper doors on cement batching equipment and in other dusty environment.

INTERCHANGEABILITY

Solenoids and pilot sections are interchangeable from one valve size to another, minimizing spare parts requirements. Adaptation to any practical voltage is achieved by a simple coil change.

Speed of response, speed of installation and dependable leakproof operation year in and year out are responsible for the increasing switch to Crescent valves on production machinery where time is money.

For complete data write for Catalog 6-C.

BARKSDALE VALVES

5125 Alcoa Avenue, Los Angeles 58, California

CIRCLE 17 ON READER SERVICE CARD

CIRCLE 43 ON READER SERVICE CARD

NEW reversible **GAST** rotary **No. 6 AIR MOTOR** delivers

TWO HORSEPOWER
. . . weighs only 17 pounds

Here's compact, light-weight power with many advantages as original equipment or for plant use! With this new 2 h.p. Model 6AM, the Gast line of rotary air motors now includes five popular sizes from 1/20 h.p. to 4 h.p.

Some models are available with either foot or flange mountings for horizontal or vertical direct, belt, or gear driving . . . special reversible rotation, etc. Gast Air Motors are *explosion-proof, variable-speed, burn-out proof* and *low in first cost!*

Write for Model 6AM Bulletin 657 (or specify h.p. that interests you) *and request "Application Ideas" Booklet also!*

Gast Manufacturing Corp., Box 117-D
Benton Harbor, Michigan.

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY
- AIR MOTORS TO 4 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

See Our Catalog in Sweet's Product Design File

MIGHTY MIDGETS

MAC-38S
Single Rod, Double Acting Air Cylinder

MAC-38D
Double Rod, Double Acting Air Cylinder

MAC-38S
Spring Return, Single Acting Air Cylinder

MAN-12
12-Port Manifold

MAV-2 & 3
2 and 3-Way Air Valves

. . . that SAVE SPACE and WEIGHT when You AUTOMATE!

You are sure to find these miniature but MIGHTY pneumatic cylinders, valves and accessories most useful for automatic work and control applications, especially where savings of weight and space are a MUST!

Clippard's versatile line of air components are "precisioneered" for millions of cycles of trouble-free operation. Small and easily mounted, they fit most anywhere to help automate your present work operations, or to improve equipment you are now designing.

Put these mighty midgets to work for you, NOW, to increase production and improve work quality AUTOMATICALLY.

WRITE TODAY FOR FREE LITERATURE AND ATTRACTIVE PRICES!

Clippard INSTRUMENT LABORATORY, INC.
7350H Colerain Road, Cincinnati 24, Ohio
Manufacturers of R.F. Coils, Electronic Equipment, Miniature Pneumatic Devices

CIRCLE 29 ON READER SERVICE CARD

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Atkomatic stainless steel SOLENOID VALVE

controls high pressures!
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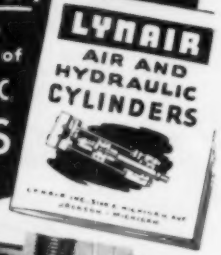

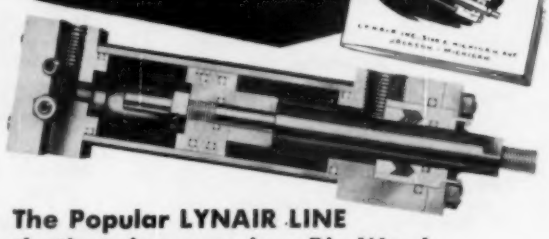

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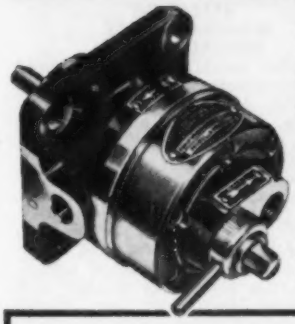

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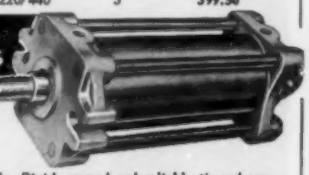

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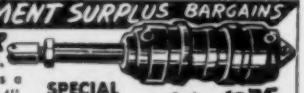

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*** A leading manufacturer of hydraulic components used a mail survey to determine which design publication best reaches the fluid power market. 3,000 customers and prospects on their mailing list were asked what publication they preferred. 80% of the men who "often" buy or specify hydraulic components preferred AH. They chose APPLIED HYDRAULICS by more than 6 to 1 over the next publication. This preference, stated in terms of advertising dollars, means it costs 65% less to reach your buyers with APPLIED HYDRAULICS than with the next publication. Ask our representative for a detailed copy of this survey.**

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Reader Response Proves Reader Interest

The following 12-month analysis of reader inquiries proves the high interest developed by APPLIED HYDRAULICS advertising and editorial. It also shows the type of products that interest APPLIED HYDRAULICS readers.

Accumulators and Boosters	1,360	Hose and Assemblies	2,945	Production Tools	1,165
Closures and Plugs	706	Fittings — Air and Oil	2,957	Pumps and Motors — Oil	7,326
Compressors and Air Pumps	1,089	Instruments	2,091	Rings — Piston and Rods	578
Custom Forming and Fabricating	229	General Hydraulic Components	3,072	Testing Equipment	313
Cylinders — Air and Oil	4,031	Heat Exchangers	529	Tubing	1,504
Electrical Components	3,160	Hydraulic Fluids	1,108	Valves — Air	3,042
Filters — Air and Oil	3,887	Motors — Electric	608	Valves — Oil	7,417
		Package Power Units	618	Miscellaneous	1,732
		Packings and Seals	9,524	Couplings Flexible Shaft	1,264
				TOTAL	63,461

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